FIG. 1

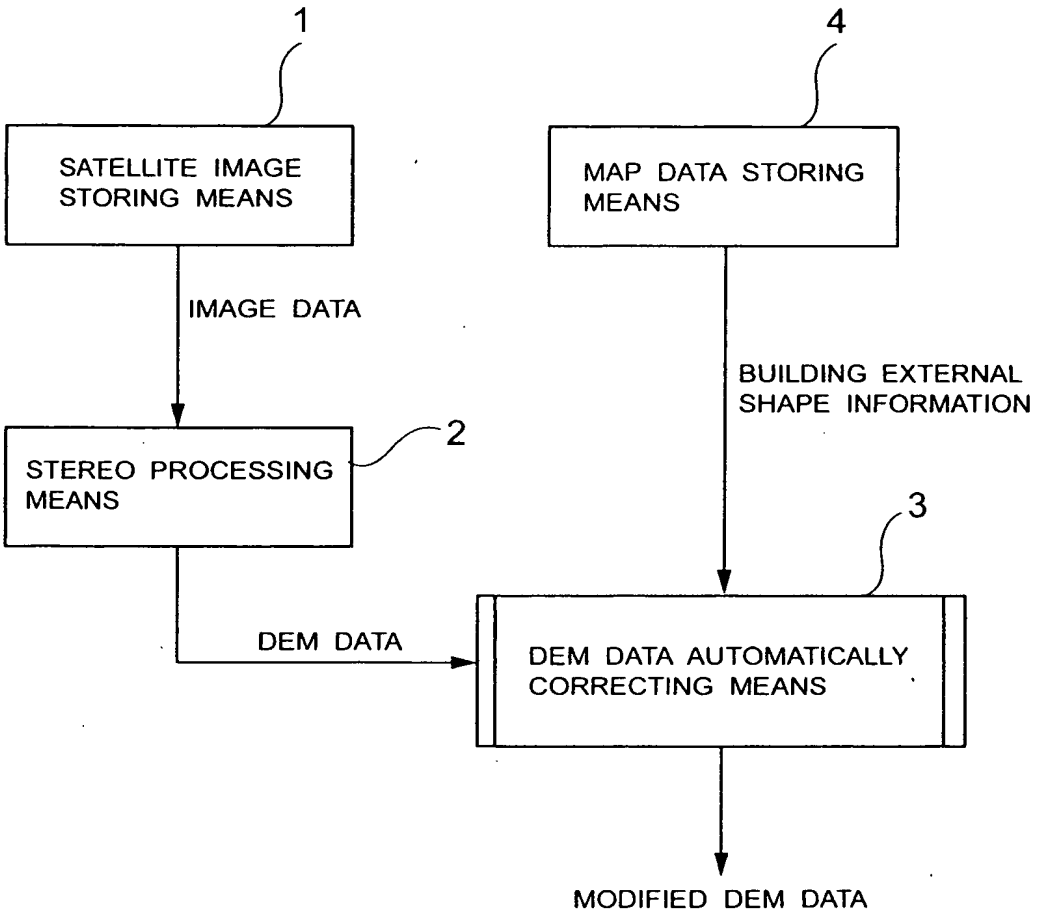


FIG. 2

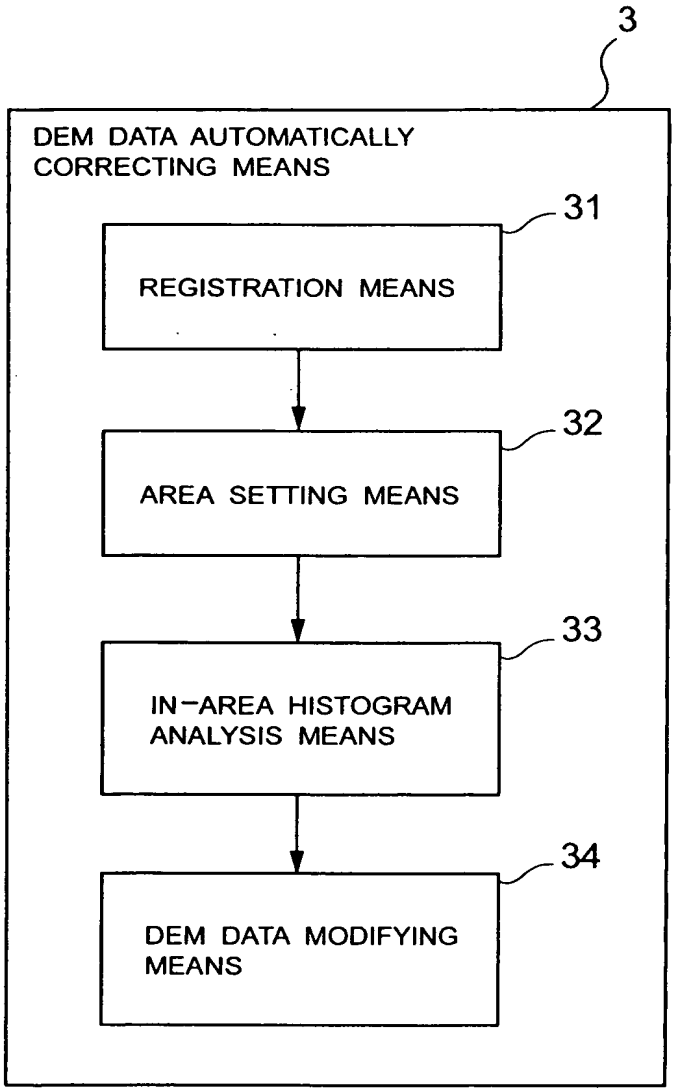


FIG. 3

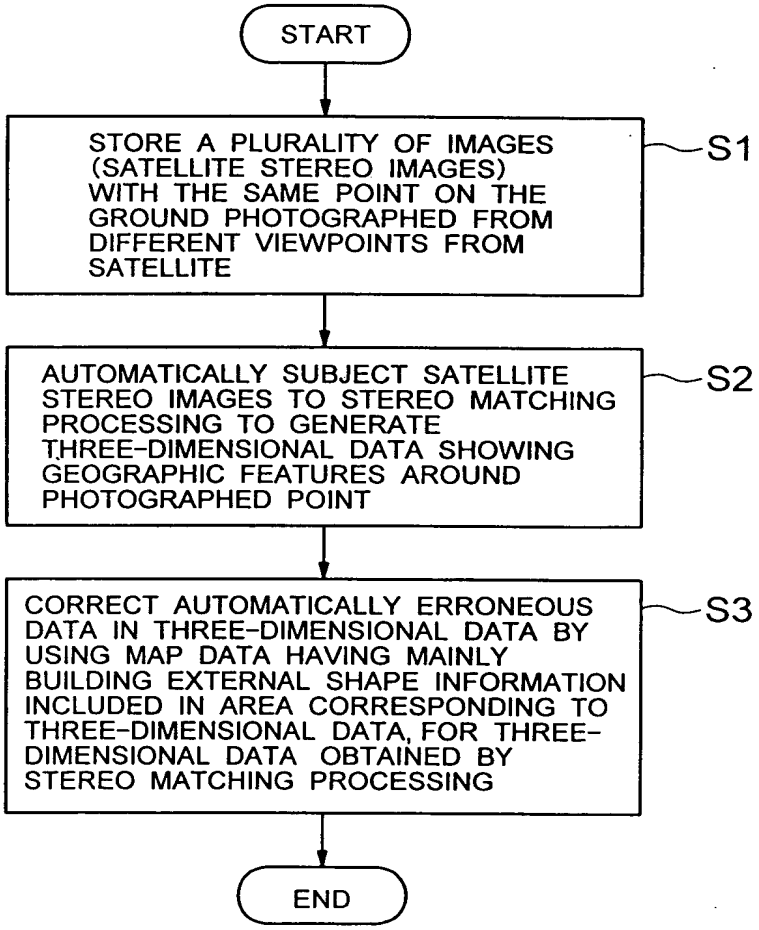

START
STORE A PLURALITY OF IMAGES (SATELLITE STEREO IMAGES) WITH THE SAME POINT ON THE GROUND PHOTOGRAPHED FROM DIFFERENT VIEWPOINTS FROM SATELLITE
S1
AUTOMATICALLY SUBJECT SATELLITE STEREO IMAGES TO STEREO MATCHING PROCESSING TO GENERATE THREE-DIMENSIONAL DATA SHOWING GEOGRAPHIC FEATURES AROUND PHOTOGRAPHED POINT
S2
CORRECT AUTOMATICALLY ERRONEOUS DATA IN THREE-DIMENSIONAL DATA BY USING MAP DATA HAVING MAINLY BUILDING EXTERNAL SHAPE INFORMATION INCLUDED IN AREA CORRESPONDING TO THREE-DIMENSIONAL DATA, FOR THREE-DIMENSIONAL DATA OBTAINED BY STEREO MATCHING PROCESSING
S3
END

FIG. 4

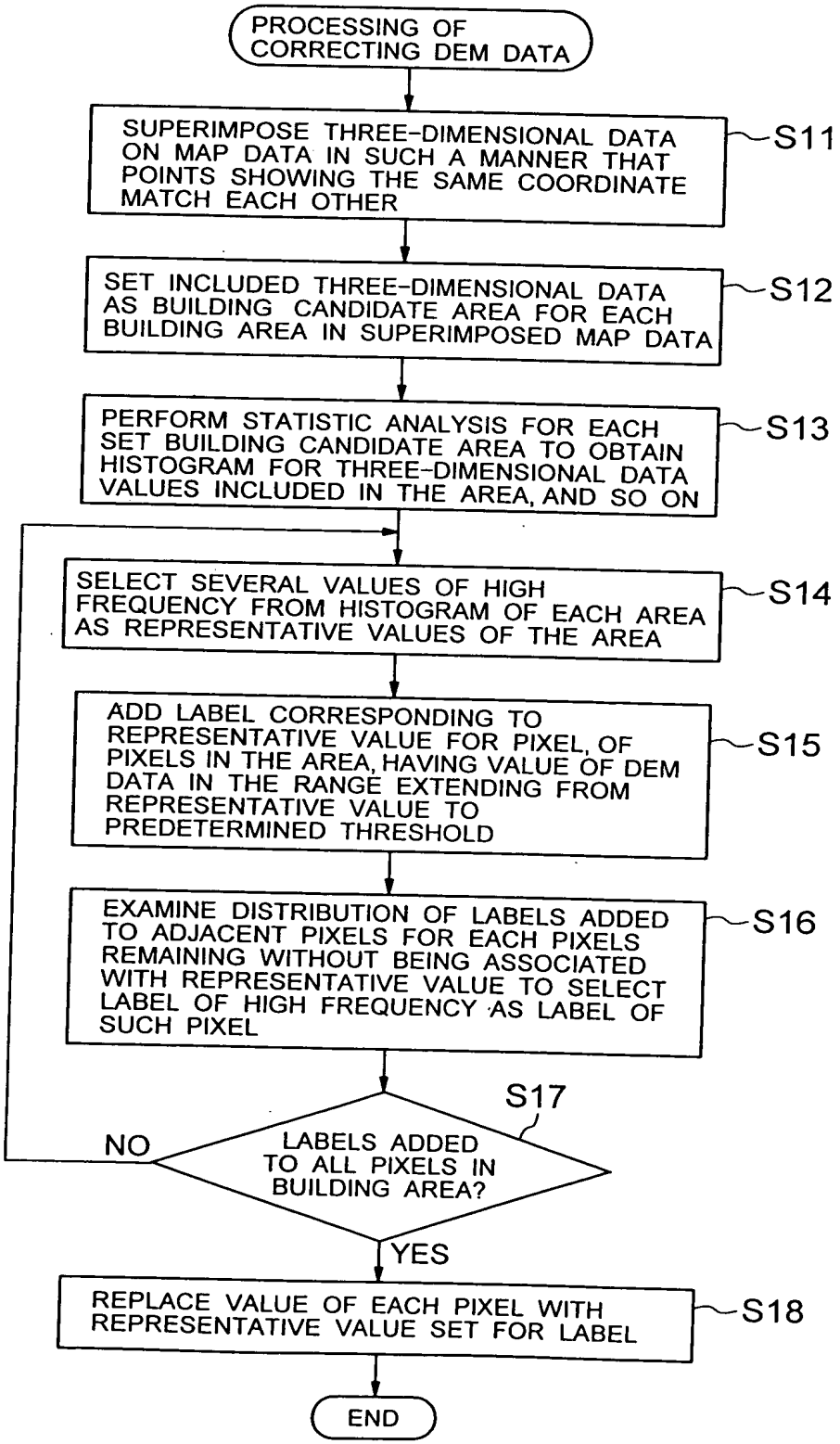


FIG.5

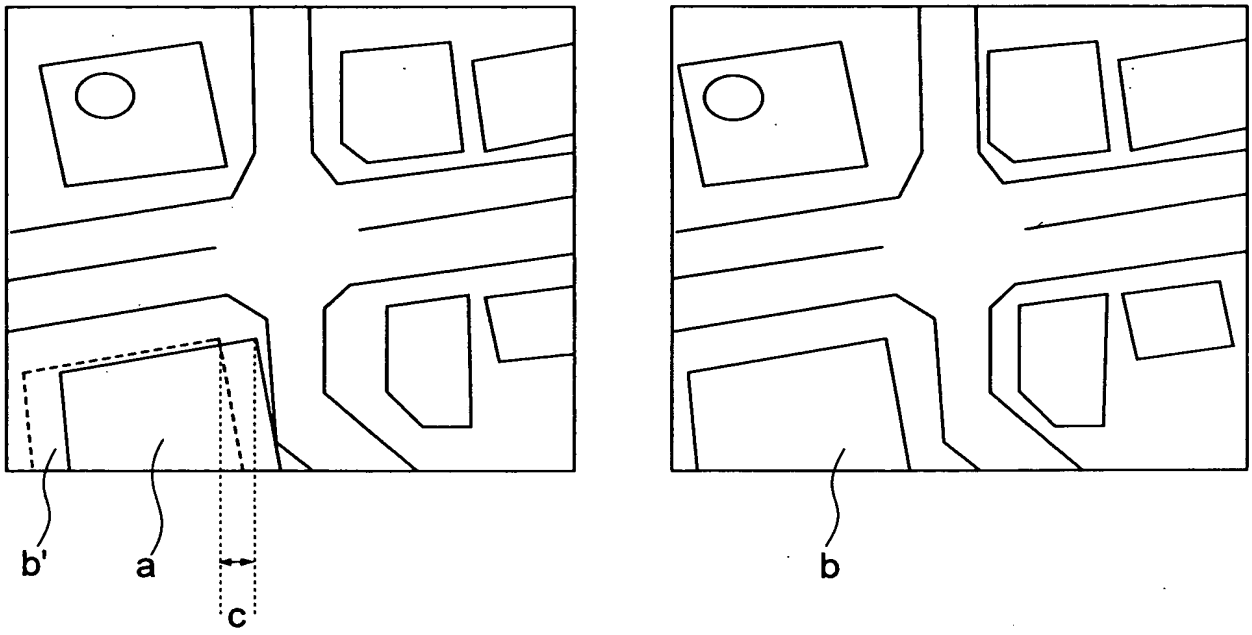


FIG.6A

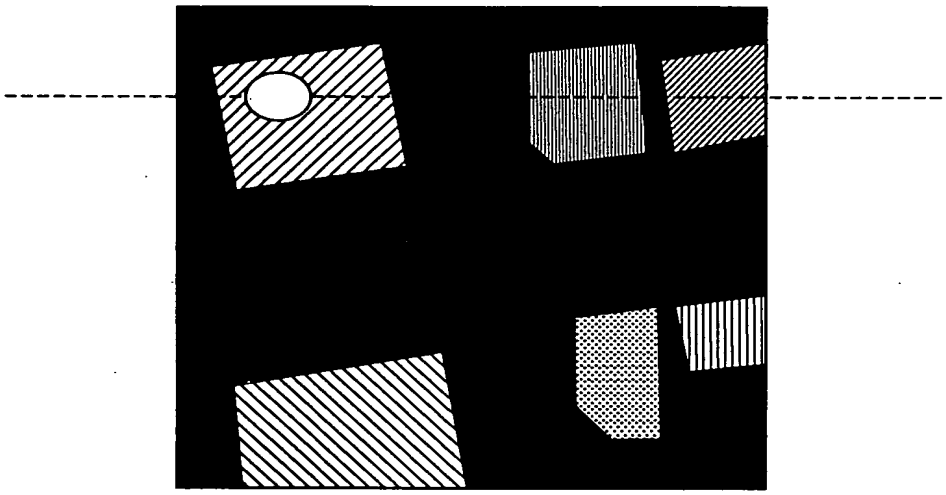


FIG.6B

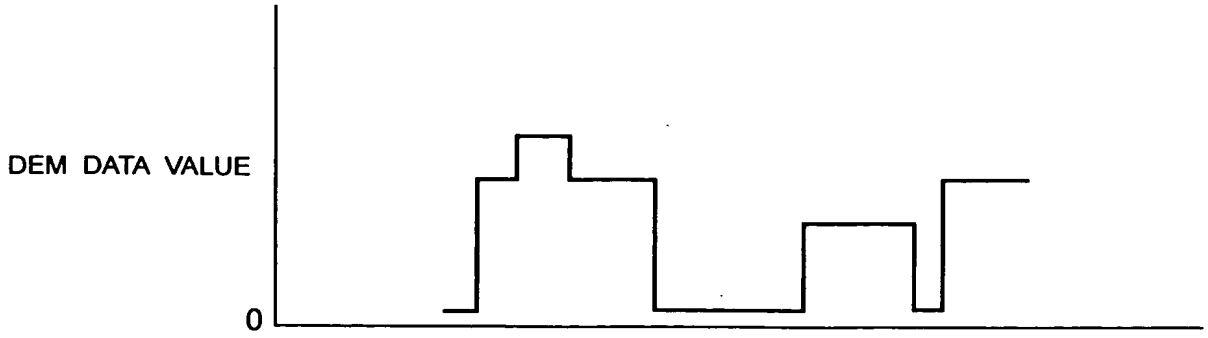


FIG.7

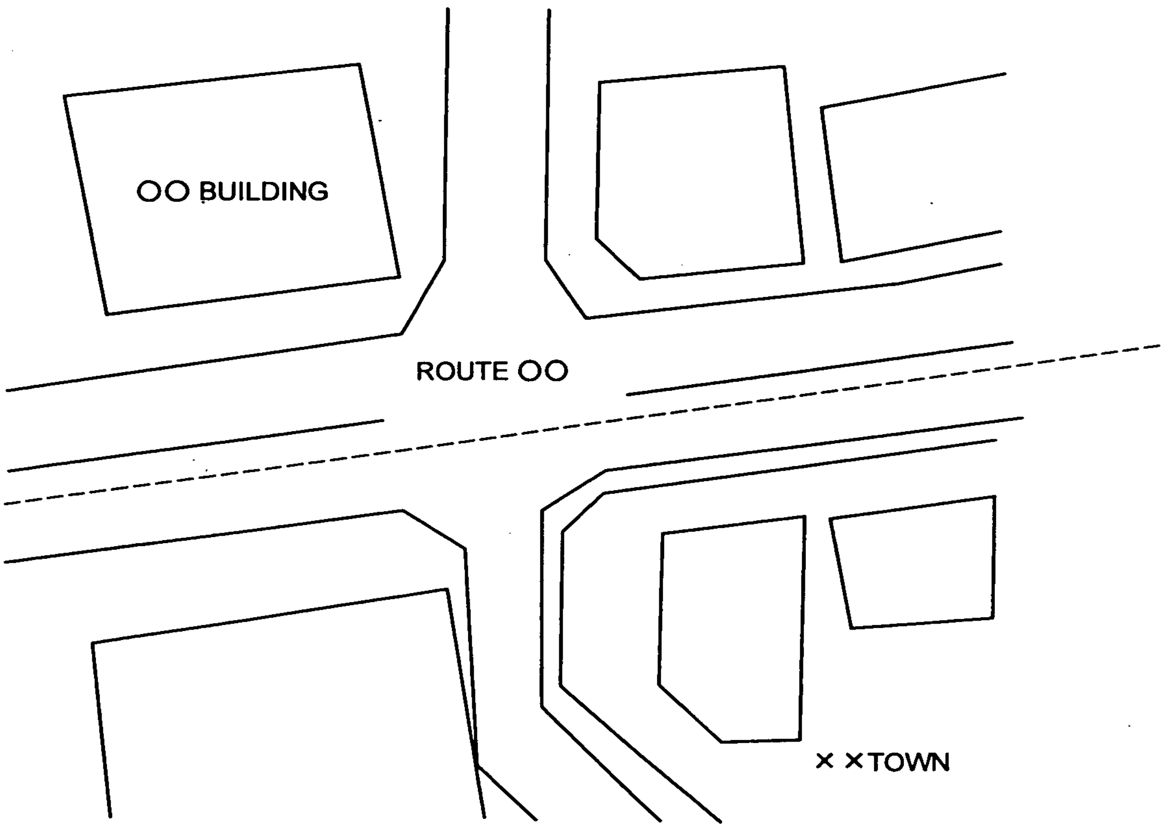


FIG.8A

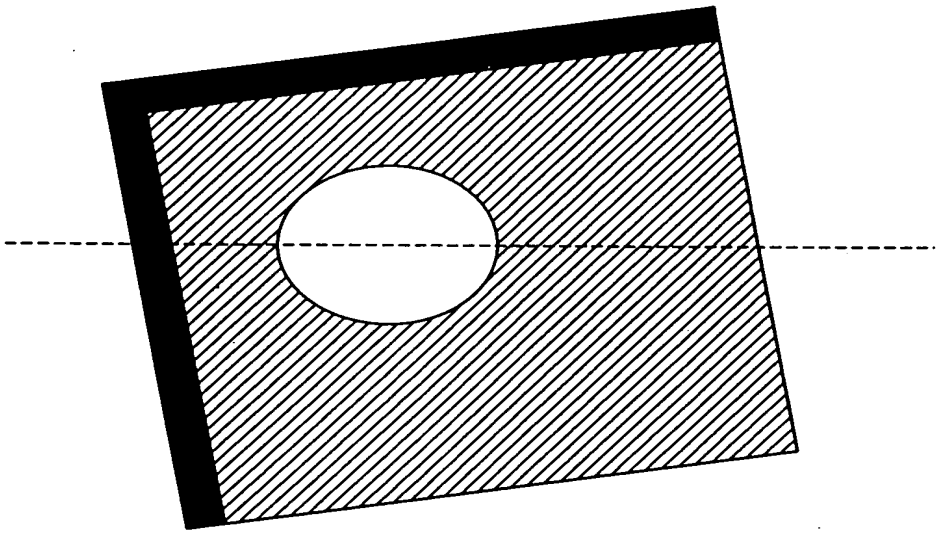


FIG.8B

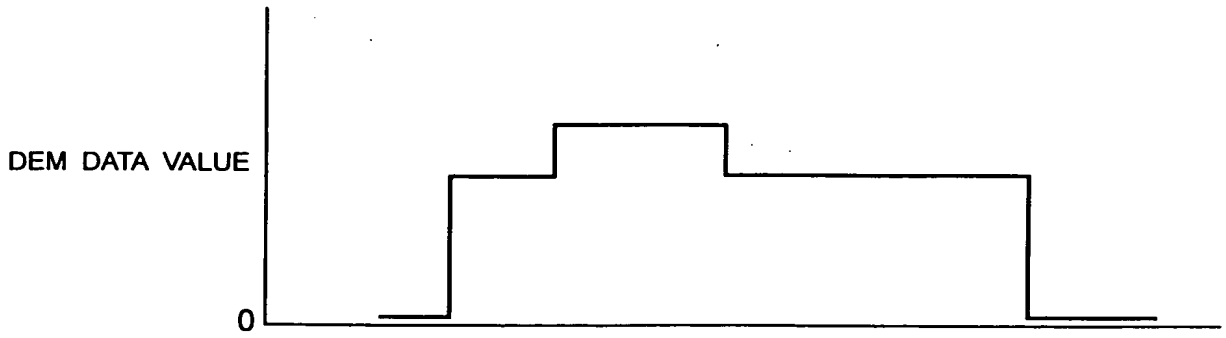


FIG.9

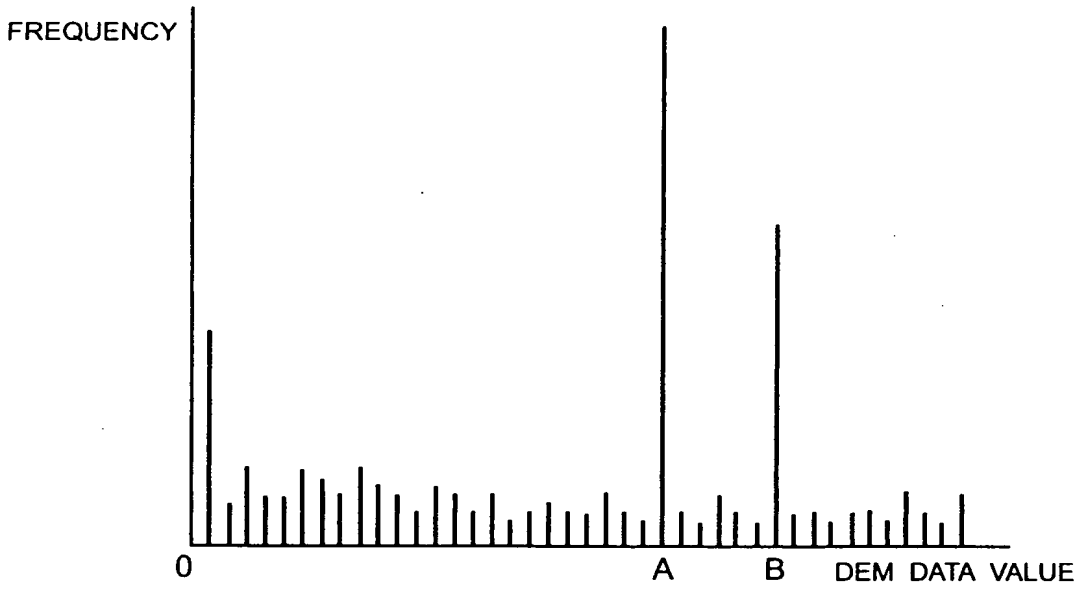


FIG.10A

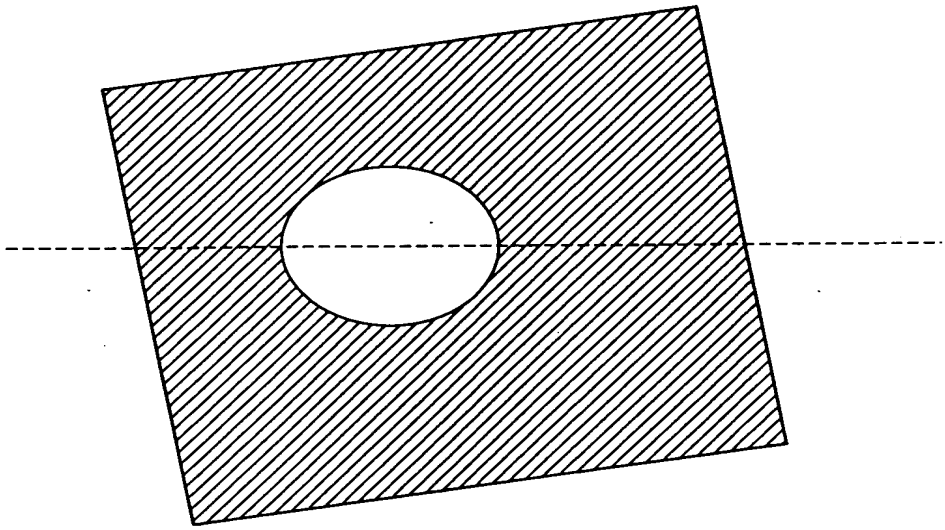


FIG.10B

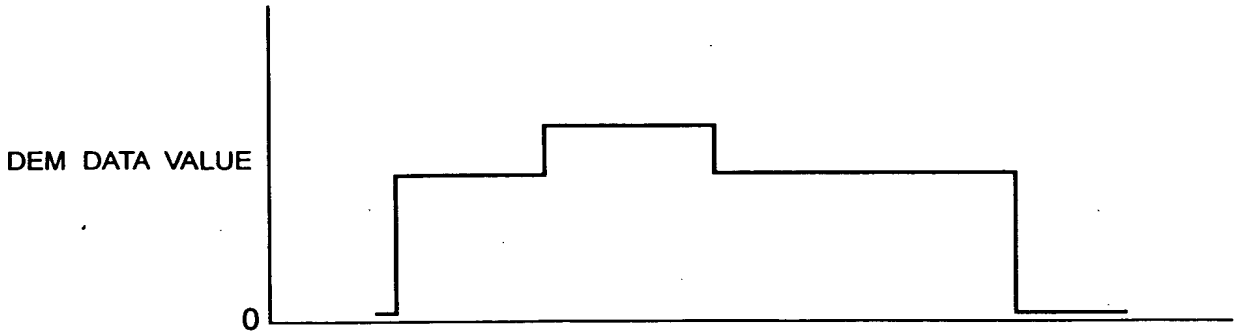


FIG. 11

1	1	1	1	1	1	4	4	5	5	5	5
1	1	1	4	4	4	4	5	5	5	5	5
1	4	4	4	5	5	5	5	5	5	6	6
4	4	5	5	5	5	6	8	8	6	8	8
4	5	5	5	5	5	6	8	6	7	8	8
5	5	5	5	5	5	5	6	7	8	8	8
5	5	5	5	5	5	6	7	8	8	8	8
5	5	5	5	5	5	6	8	8	8	8	8

FIG.12

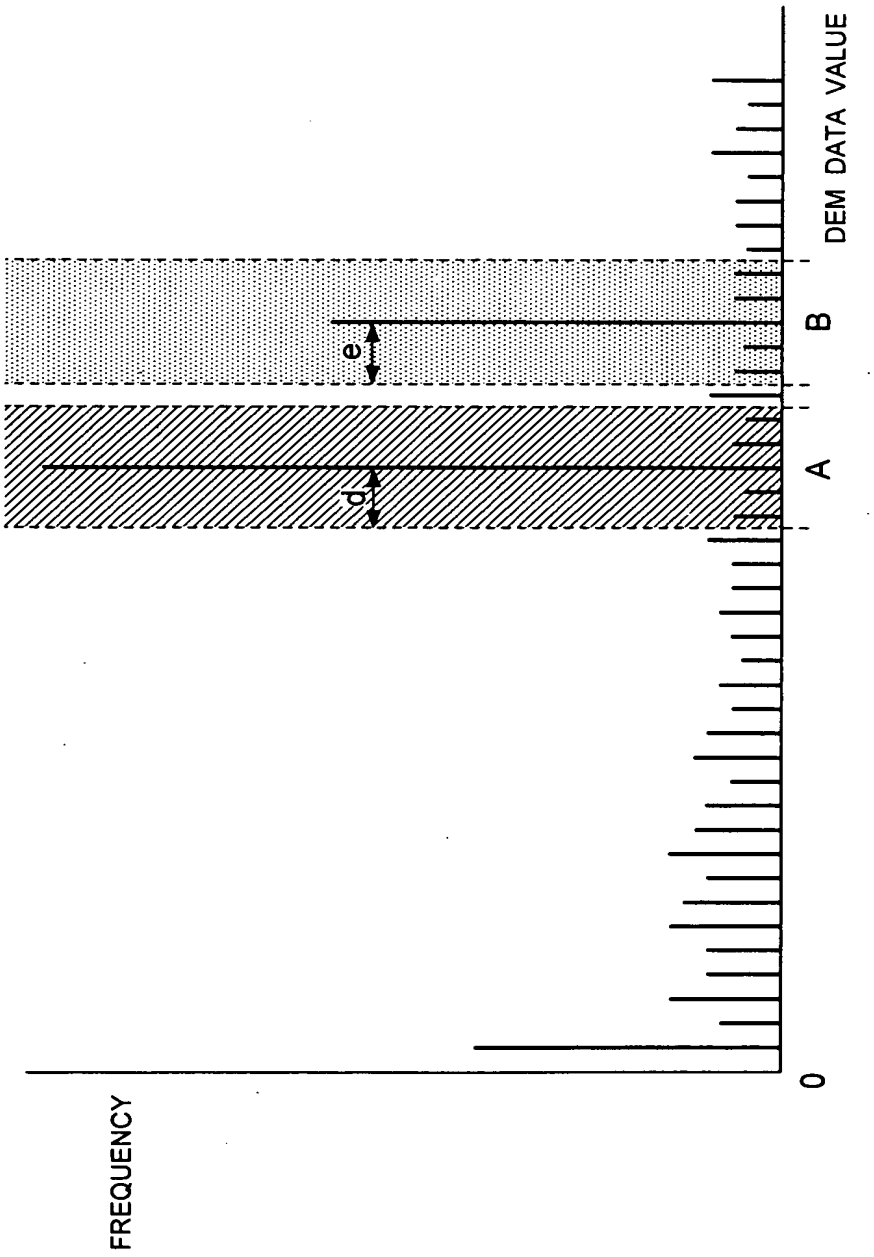


FIG. 13

1	1	1	1	1	1	A	A	A	A	A	A
1	1	1	A	A	A	A	A	A	A	A	A
1	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	B	B
A	A	A	A	A	A	A	A	A	B	B	B
A	A	A	A	A	A	A	A	B	B	B	B
A	A	A	A	A	A	A	B	B	B	B	B
A	A	A	A	A	A	A	B	B	B	B	B

FIG. 14

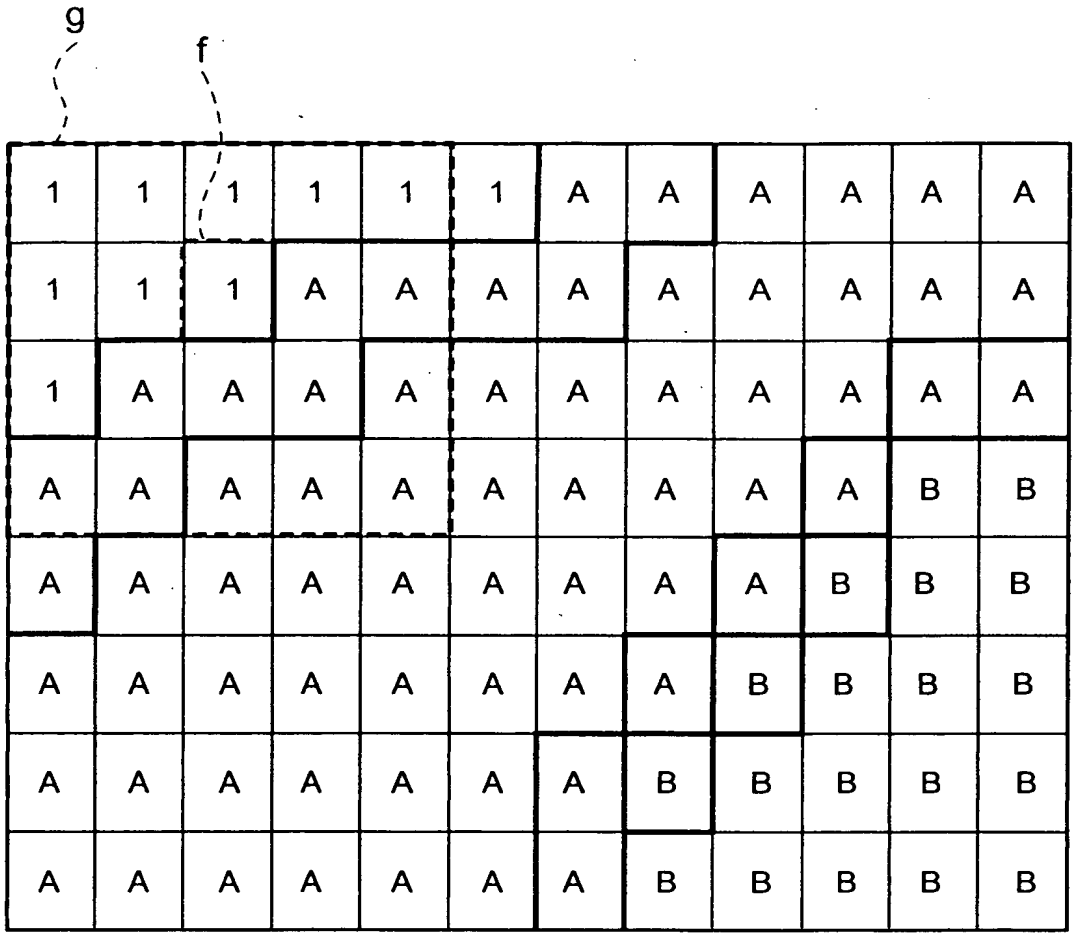


FIG. 15

A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	A	A
A	A	A	A	A	A	A	A	A	A	B	B
A	A	A	A	A	A	A	A	A	B	B	B
A	A	A	A	A	A	A	A	B	B	B	B
A	A	A	A	A	A	A	B	B	B	B	B
A	A	A	A	A	A	A	B	B	B	B	B

FIG. 16

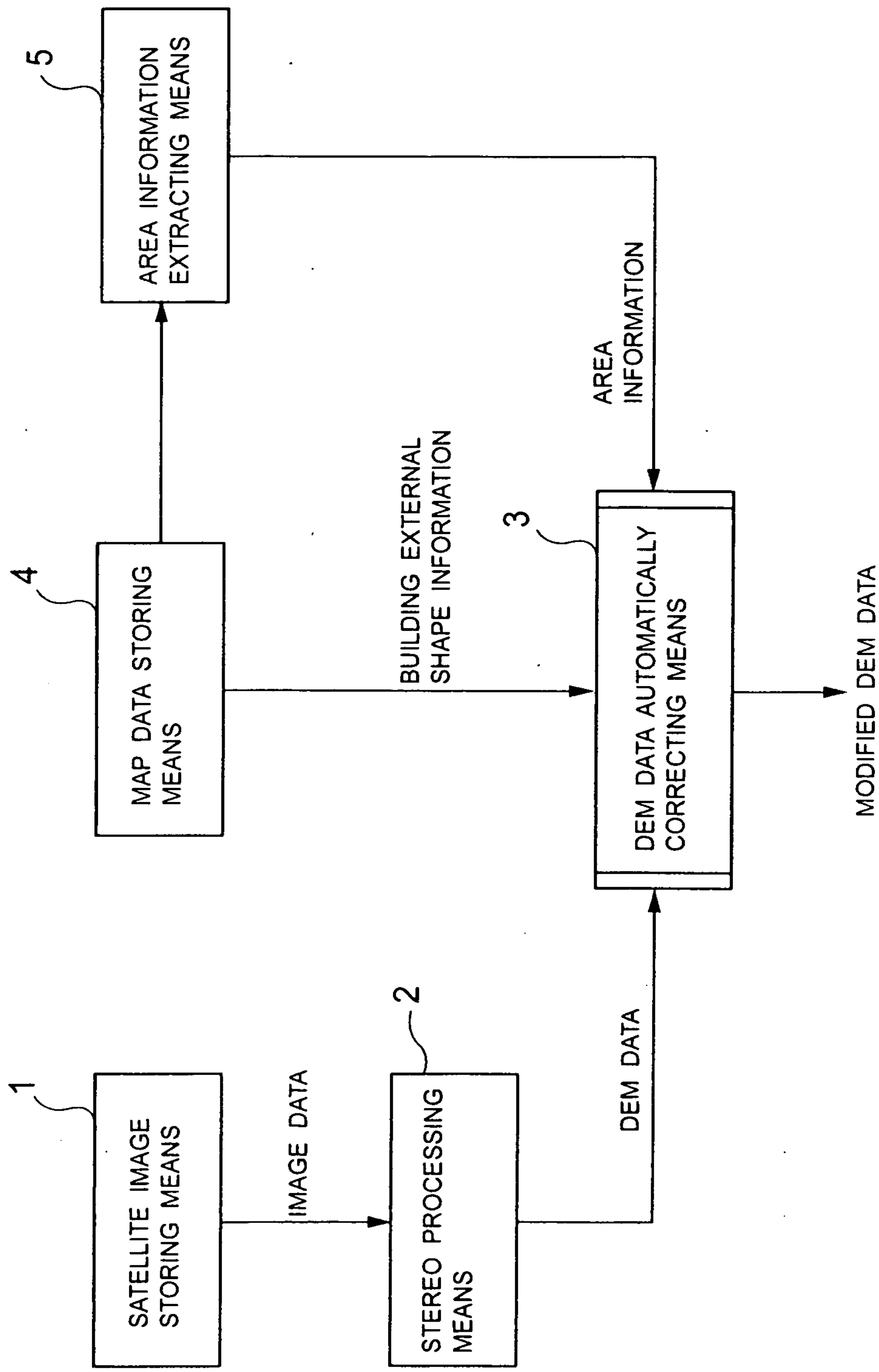

1
SATELLITE IMAGE STORING MEANS
IMAGE DATA
2
STEREO PROCESSING MEANS
DEM DATA
4
MAP DATA STORING MEANS
BUILDING EXTERNAL SHAPE INFORMATION
5
AREA INFORMATION EXTRACTING MEANS
AREA INFORMATION
3
DEM DATA AUTOMATICALLY CORRECTING MEANS
MODIFIED DEM DATA

FIG. 17

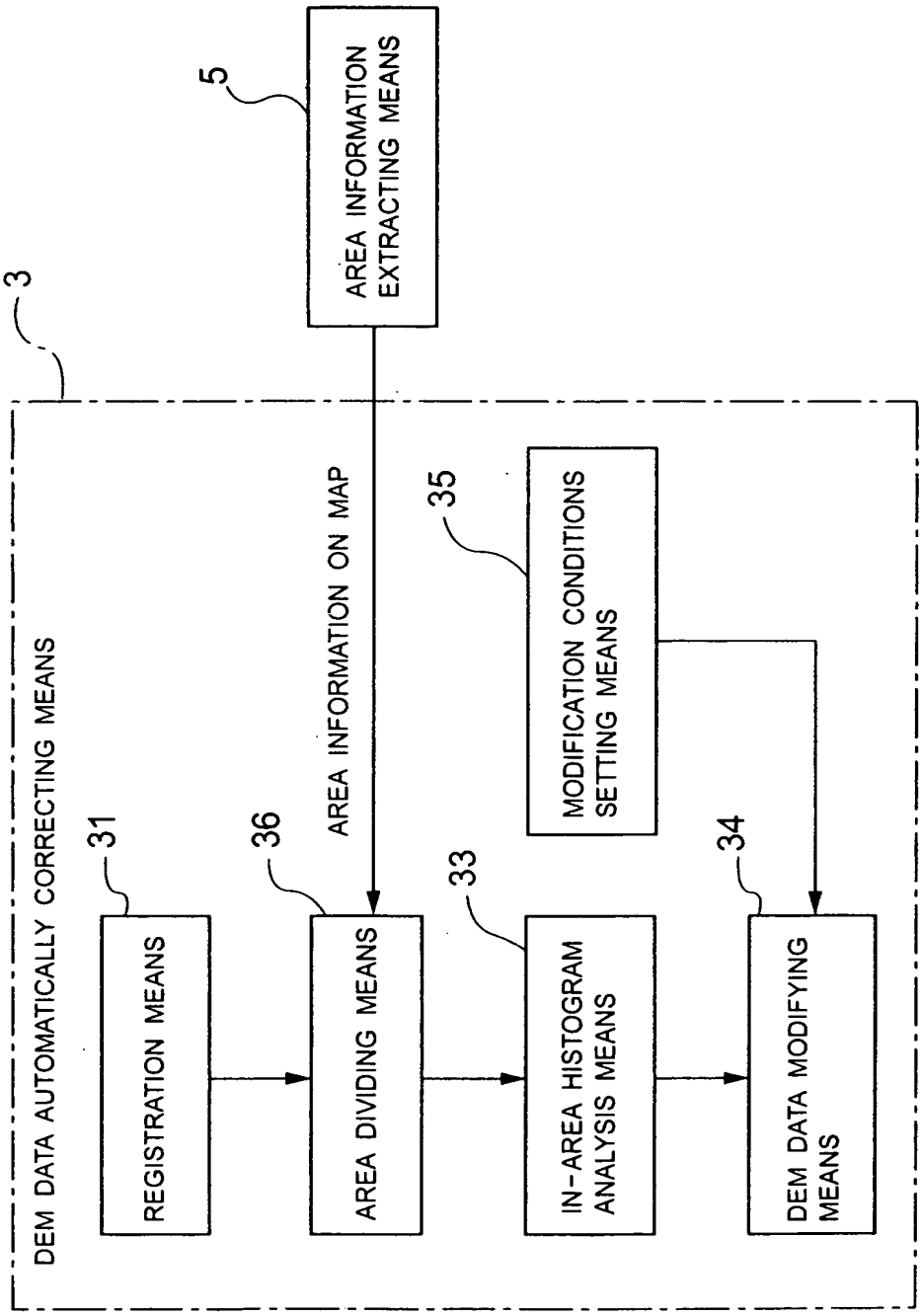

5
AREA INFORMATION EXTRACTING MEANS
3
DEM DATA AUTOMATICALLY CORRECTING MEANS
AREA INFORMATION ON MAP
35
MODIFICATION CONDITIONS SETTING MEANS
31
REGISTRATION MEANS
36
AREA DIVIDING MEANS
33
IN-AREA HISTOGRAM ANALYSIS MEANS
34
DEM DATA MODIFYING MEANS

FIG. 18

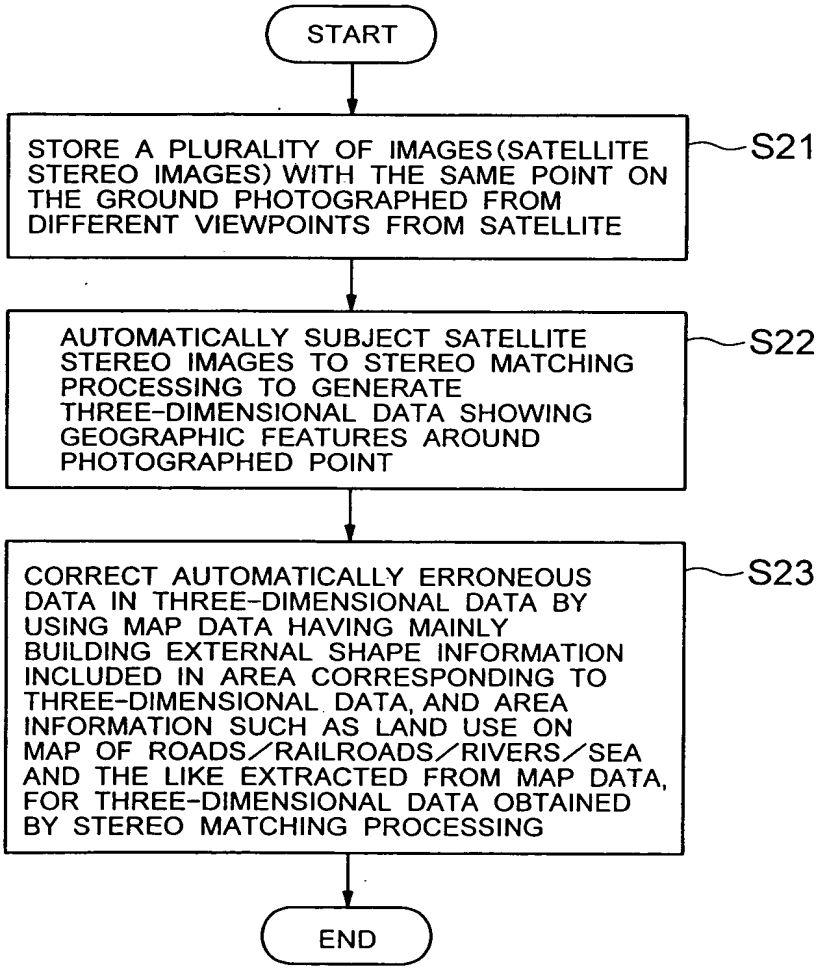


FIG. 19A

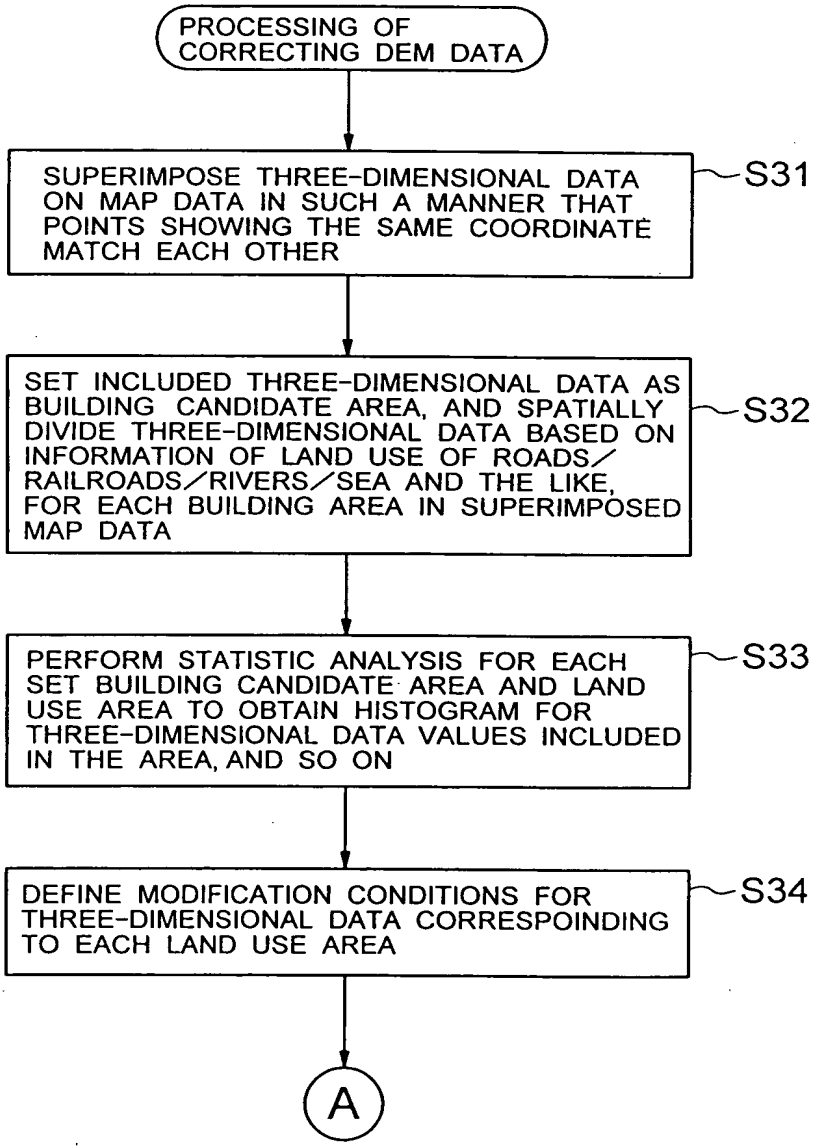

PROCESSING OF CORRECTING DEM DATA
SUPERIMPOSE THREE-DIMENSIONAL DATA ON MAP DATA IN SUCH A MANNER THAT POINTS SHOWING THE SAME COORDINATE MATCH EACH OTHER
S31
SET INCLUDED THREE-DIMENSIONAL DATA AS BUILDING CANDIDATE AREA, AND SPATIALLY DIVIDE THREE-DIMENSIONAL DATA BASED ON INFORMATION OF LAND USE OF ROADS/RAILROADS/RIVERS/SEA AND THE LIKE, FOR EACH BUILDING AREA IN SUPERIMPOSED MAP DATA
S32
PERFORM STATISTIC ANALYSIS FOR EACH SET BUILDING CANDIDATE AREA AND LAND USE AREA TO OBTAIN HISTOGRAM FOR THREE-DIMENSIONAL DATA VALUES INCLUDED IN THE AREA, AND SO ON
S33
DEFINE MODIFICATION CONDITIONS FOR THREE-DIMENSIONAL DATA CORRESPOINDING TO EACH LAND USE AREA
S34
A

FIG. 19B

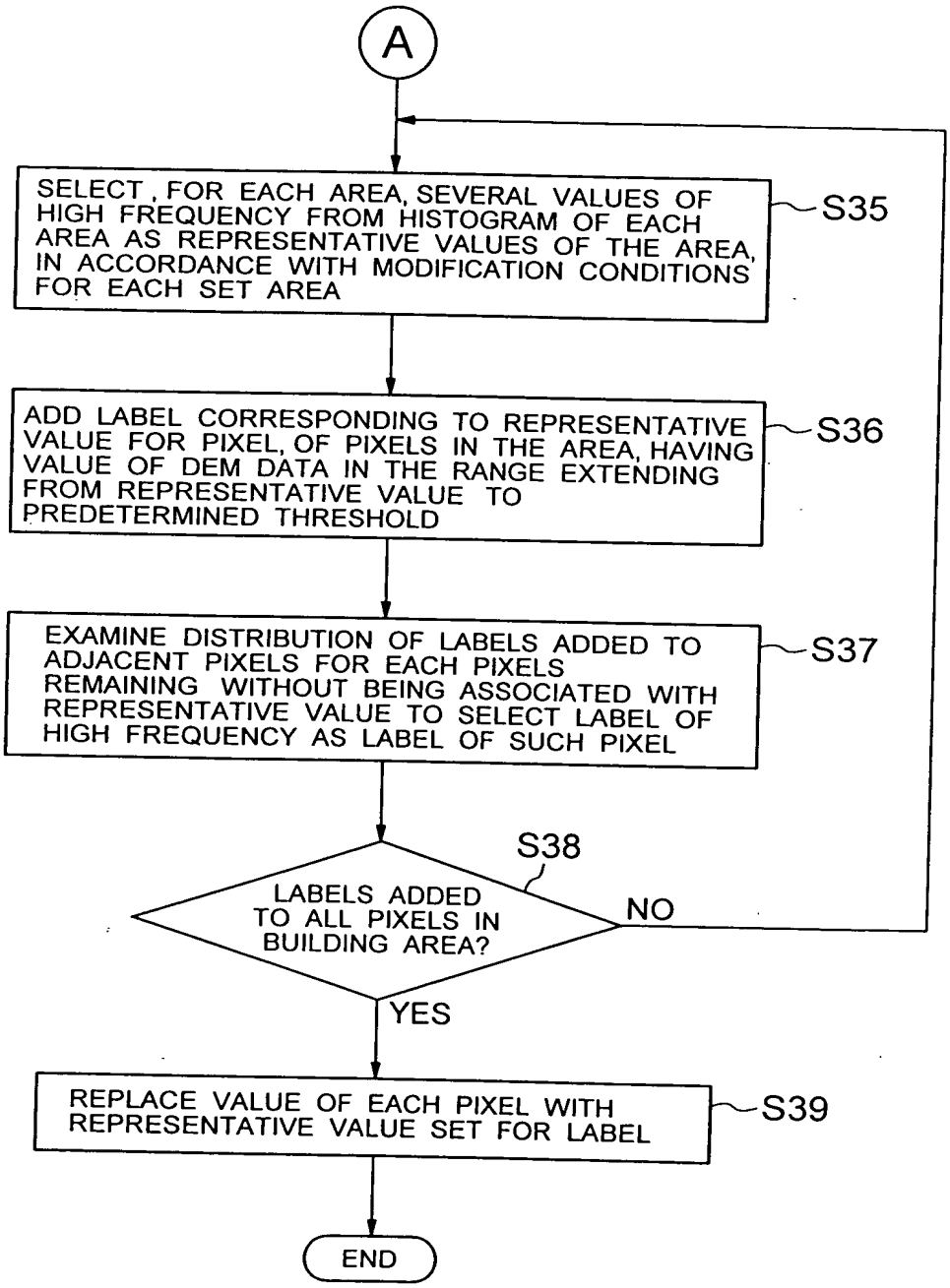

A
SELECT, FOR EACH AREA, SEVERAL VALUES OF HIGH FREQUENCY FROM HISTOGRAM OF EACH AREA AS REPRESENTATIVE VALUES OF THE AREA, IN ACCORDANCE WITH MODIFICATION CONDITIONS FOR EACH SET AREA
S35
ADD LABEL CORRESPONDING TO REPRESENTATIVE VALUE FOR PIXEL, OF PIXELS IN THE AREA, HAVING VALUE OF DEM DATA IN THE RANGE EXTENDING FROM REPRESENTATIVE VALUE TO PREDETERMINED THRESHOLD
S36
EXAMINE DISTRIBUTION OF LABELS ADDED TO ADJACENT PIXELS FOR EACH PIXELS REMAINING WITHOUT BEING ASSOCIATED WITH REPRESENTATIVE VALUE TO SELECT LABEL OF HIGH FREQUENCY AS LABEL OF SUCH PIXEL
S37
S38
LABELS ADDED TO ALL PIXELS IN BUILDING AREA?
NO
YES
REPLACE VALUE OF EACH PIXEL WITH REPRESENTATIVE VALUE SET FOR LABEL
S39
END

FIG.20

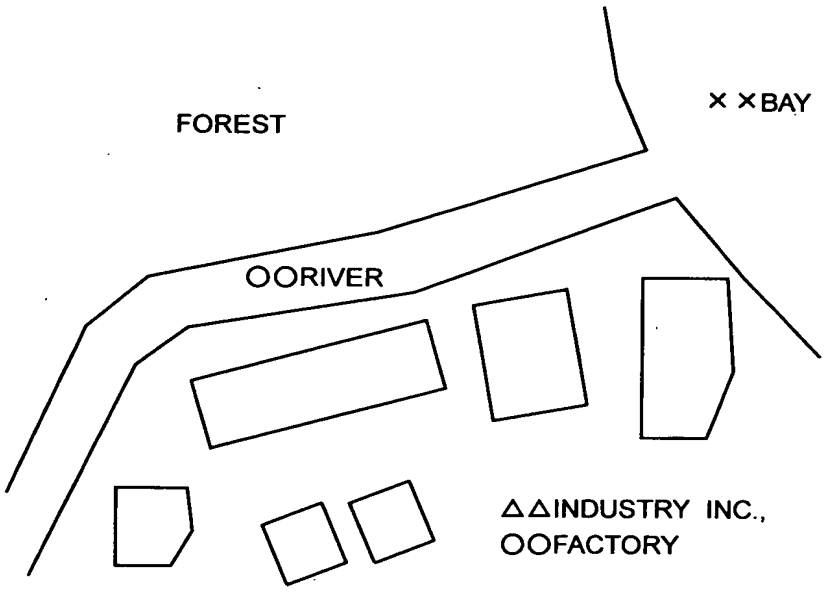


FIG. 21

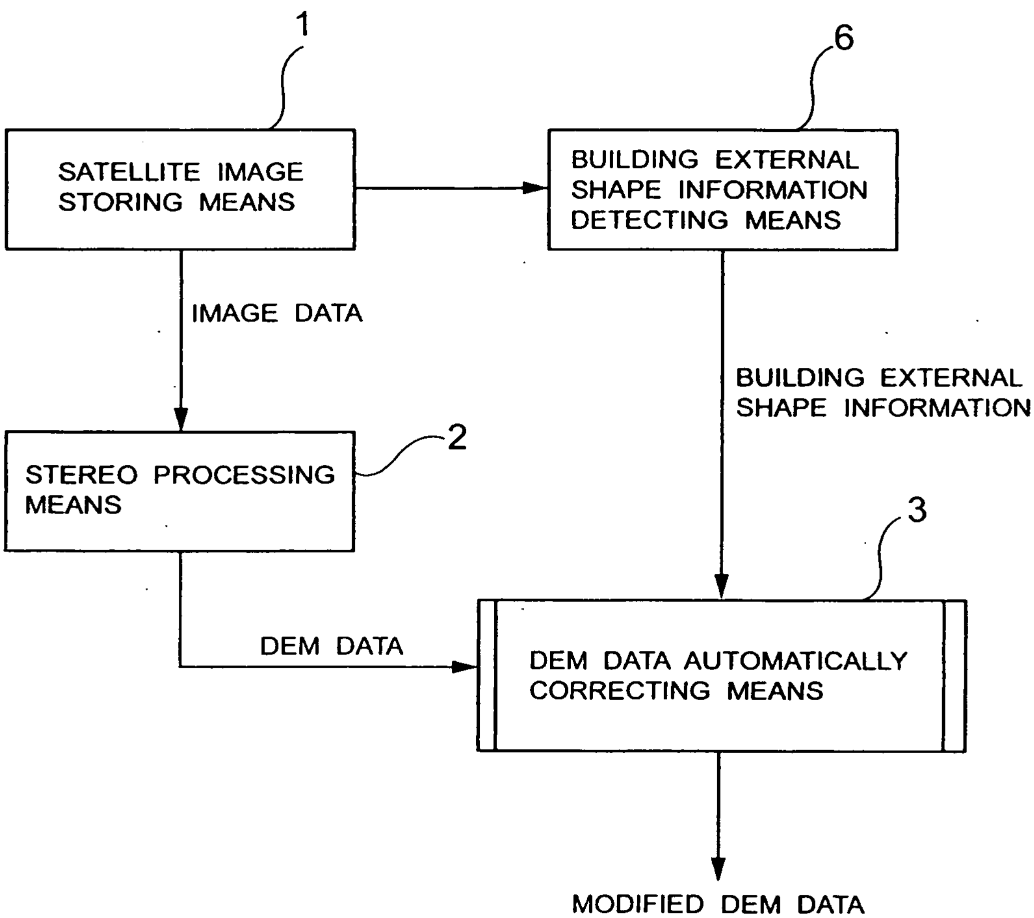


FIG. 22

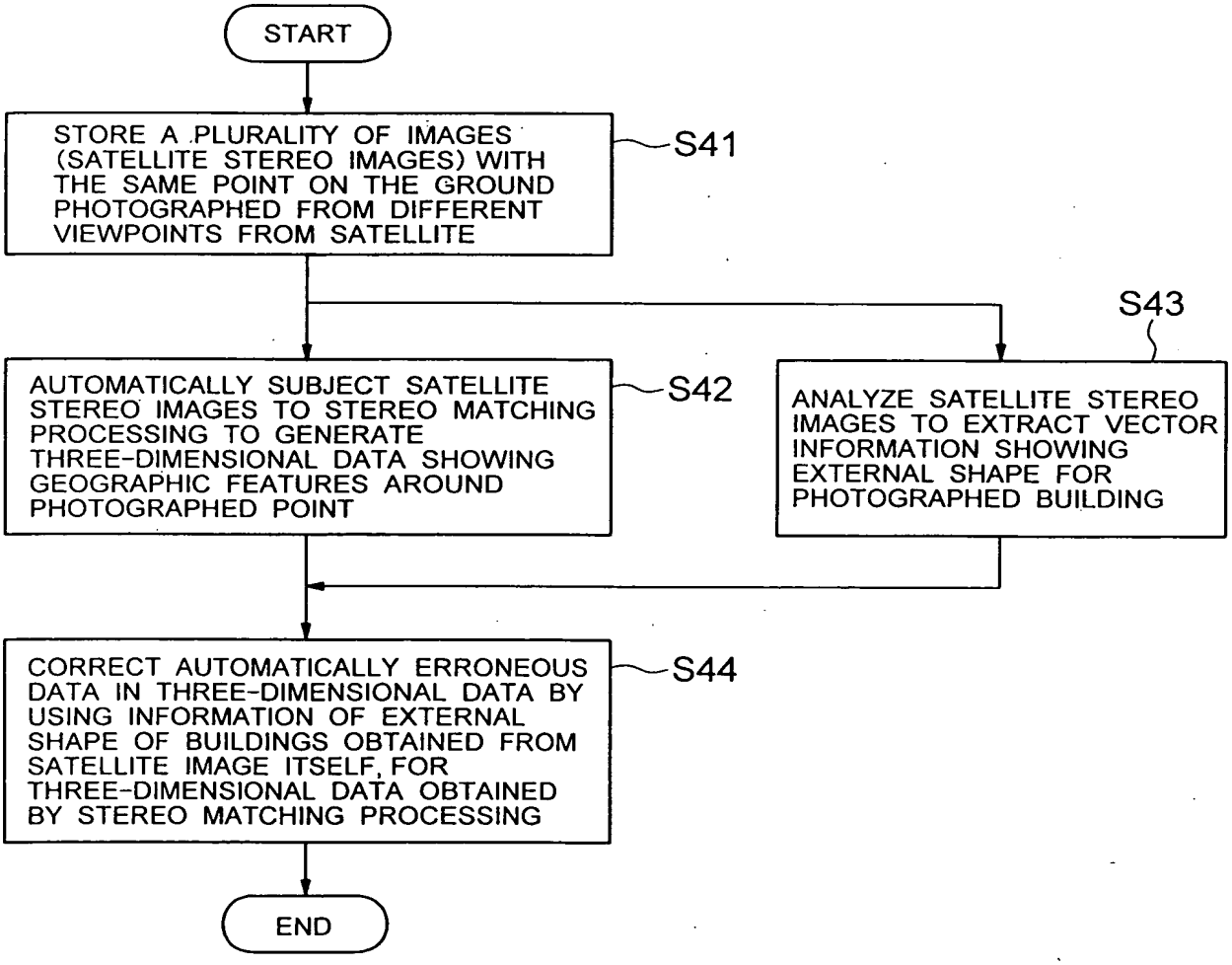


FIG. 23

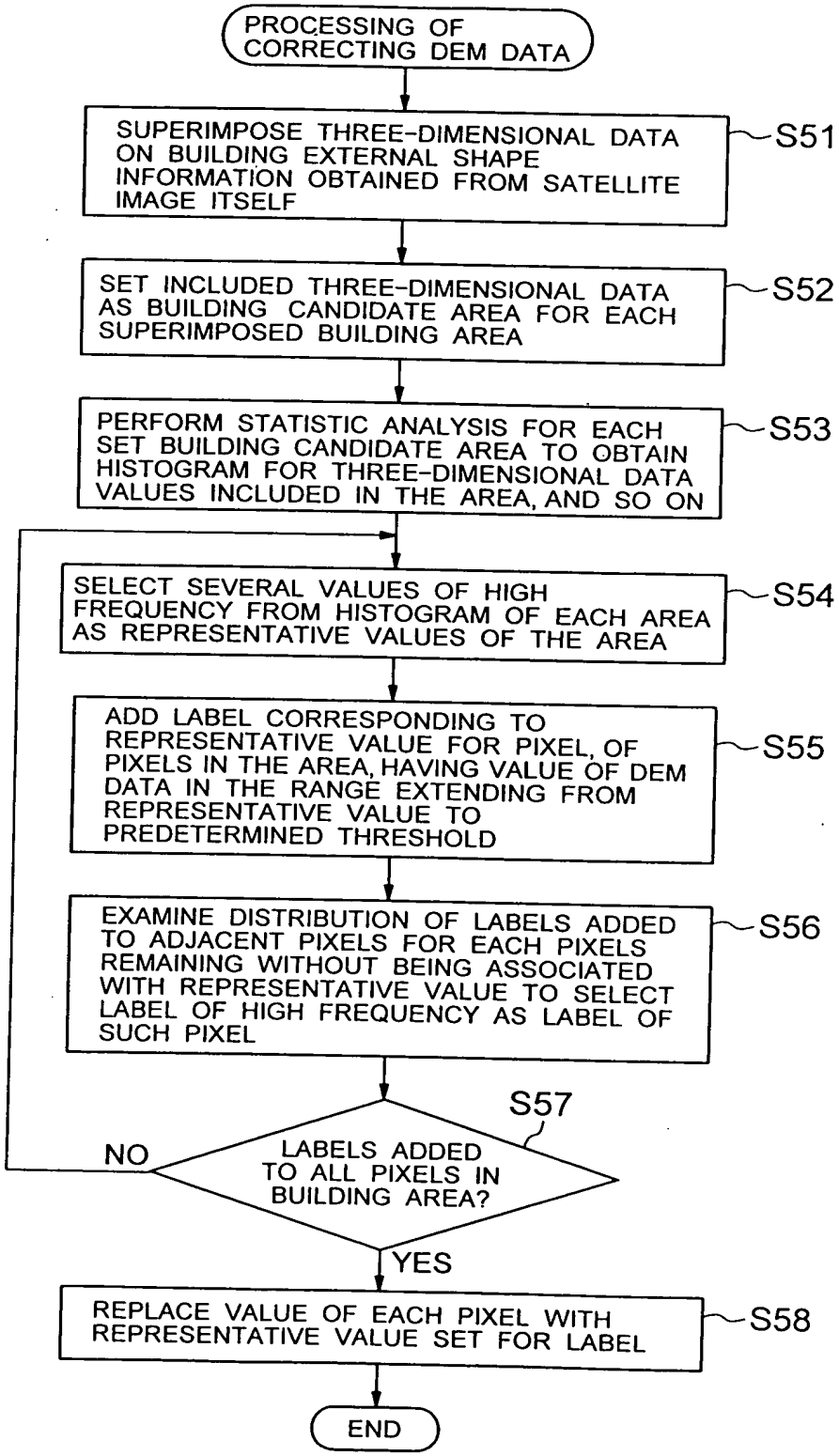


FIG. 24

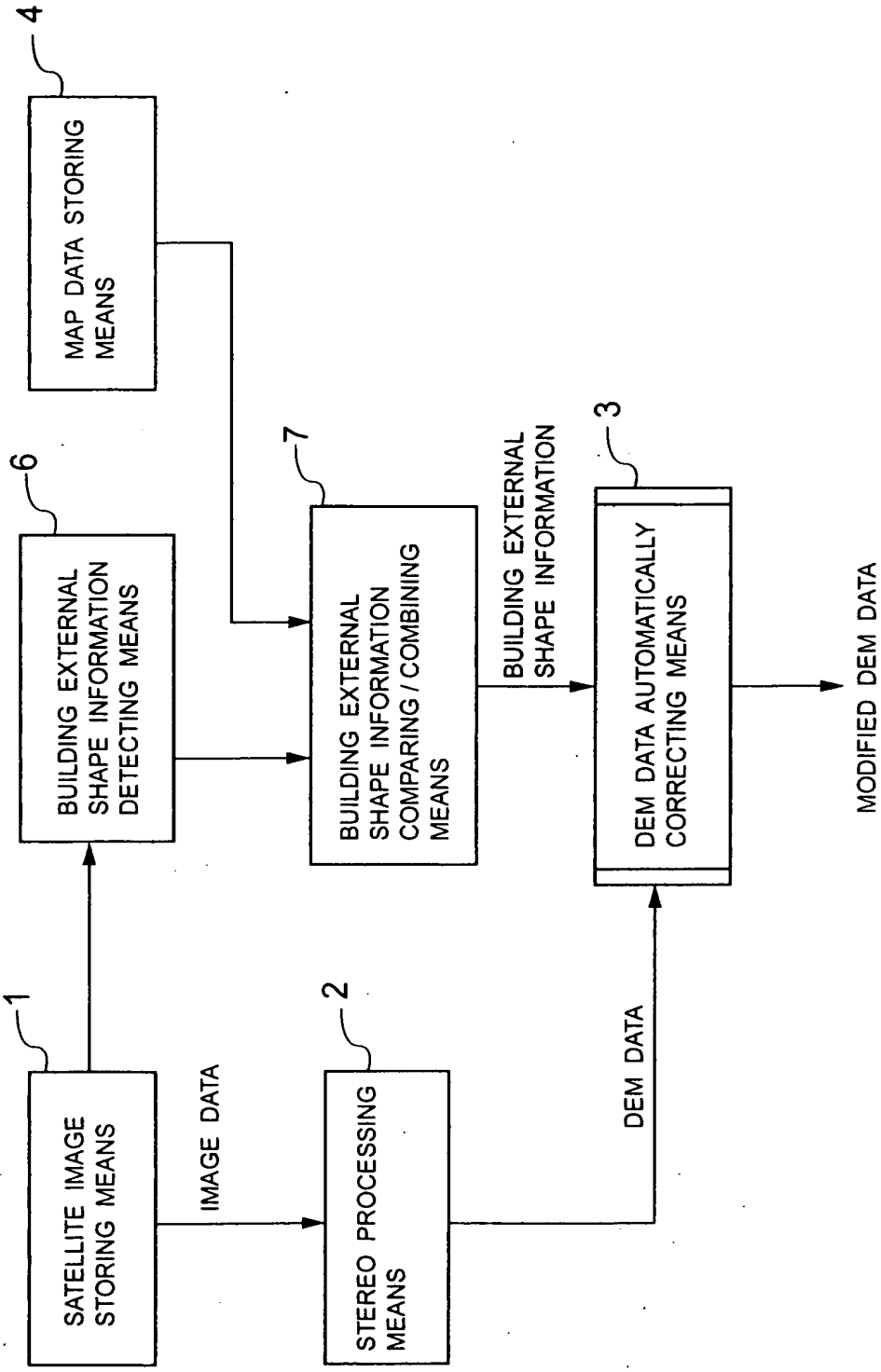

4
MAP DATA STORING MEANS
6
BUILDING EXTERNAL SHAPE INFORMATION DETECTING MEANS
7
BUILDING EXTERNAL SHAPE INFORMATION COMPARING / COMBINING MEANS
BUILDING EXTERNAL SHAPE INFORMATION
3
DEM DATA AUTOMATICALLY CORRECTING MEANS
MODIFIED DEM DATA
1
SATELLITE IMAGE STORING MEANS
IMAGE DATA
2
STEREO PROCESSING MEANS
DEM DATA

FIG. 25

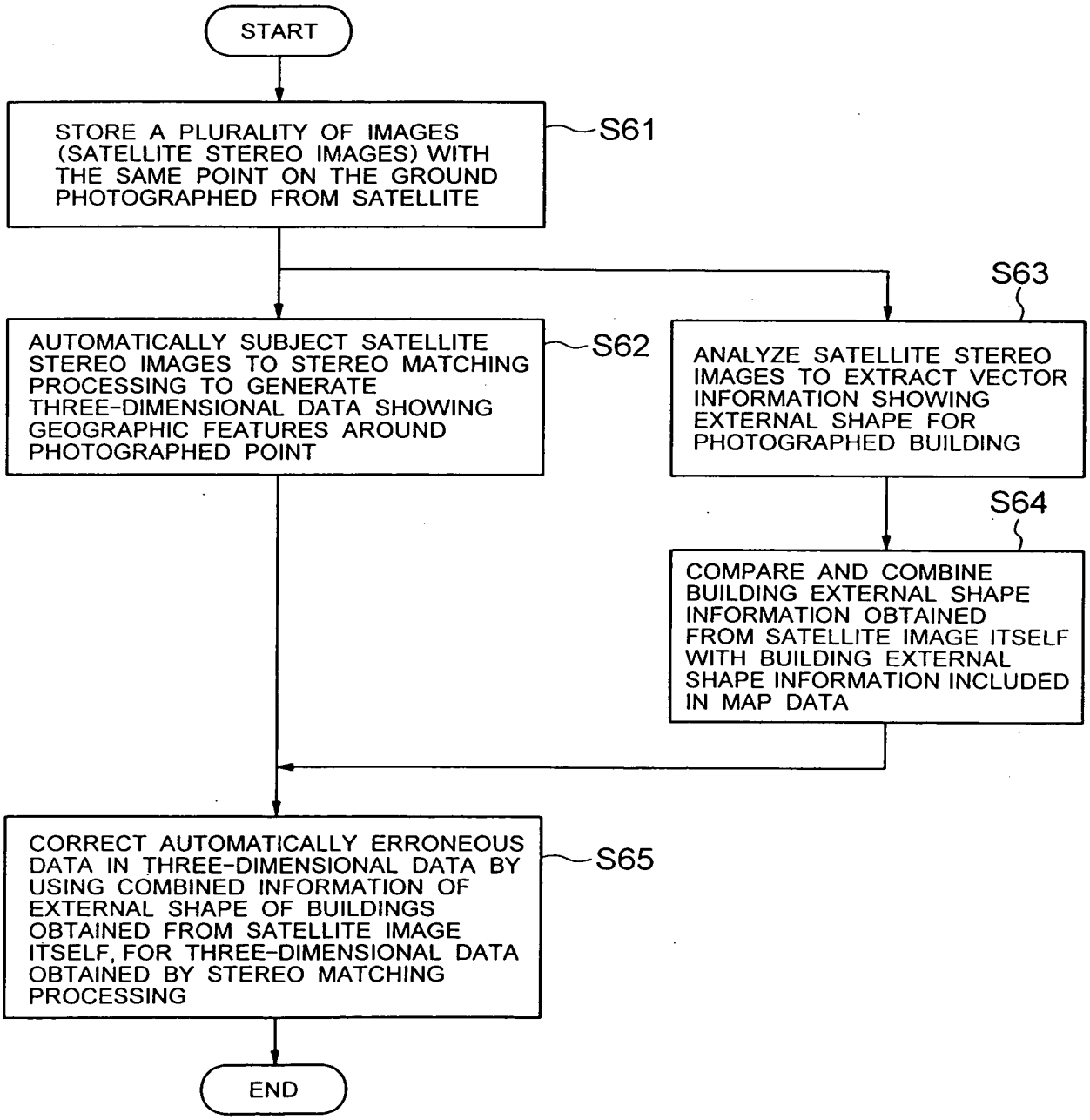


FIG. 26

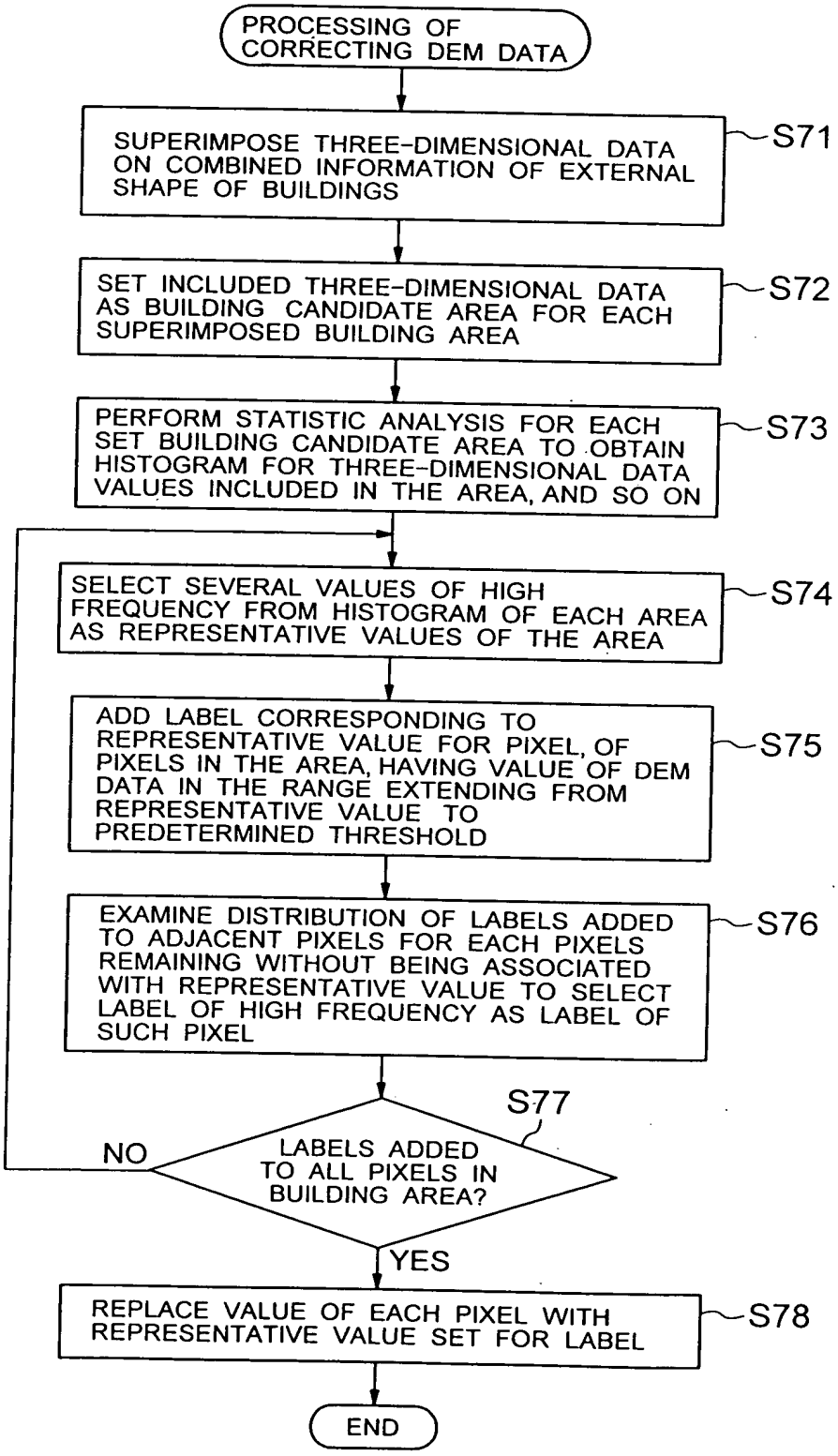

PROCESSING OF CORRECTING DEM DATA
SUPERIMPOSE THREE-DIMENSIONAL DATA ON COMBINED INFORMATION OF EXTERNAL SHAPE OF BUILDINGS
S71
SET INCLUDED THREE-DIMENSIONAL DATA AS BUILDING CANDIDATE AREA FOR EACH SUPERIMPOSED BUILDING AREA
S72
PERFORM STATISTIC ANALYSIS FOR EACH SET BUILDING CANDIDATE AREA TO OBTAIN HISTOGRAM FOR THREE-DIMENSIONAL DATA VALUES INCLUDED IN THE AREA, AND SO ON
S73
SELECT SEVERAL VALUES OF HIGH FREQUENCY FROM HISTOGRAM OF EACH AREA AS REPRESENTATIVE VALUES OF THE AREA
S74
ADD LABEL CORRESPONDING TO REPRESENTATIVE VALUE FOR PIXEL, OF PIXELS IN THE AREA, HAVING VALUE OF DEM DATA IN THE RANGE EXTENDING FROM REPRESENTATIVE VALUE TO PREDETERMINED THRESHOLD
S75
EXAMINE DISTRIBUTION OF LABELS ADDED TO ADJACENT PIXELS FOR EACH PIXELS REMAINING WITHOUT BEING ASSOCIATED WITH REPRESENTATIVE VALUE TO SELECT LABEL OF HIGH FREQUENCY AS LABEL OF SUCH PIXEL
S76
S77
LABELS ADDED TO ALL PIXELS IN BUILDING AREA?
NO
YES
REPLACE VALUE OF EACH PIXEL WITH REPRESENTATIVE VALUE SET FOR LABEL
S78
END

FIG. 27

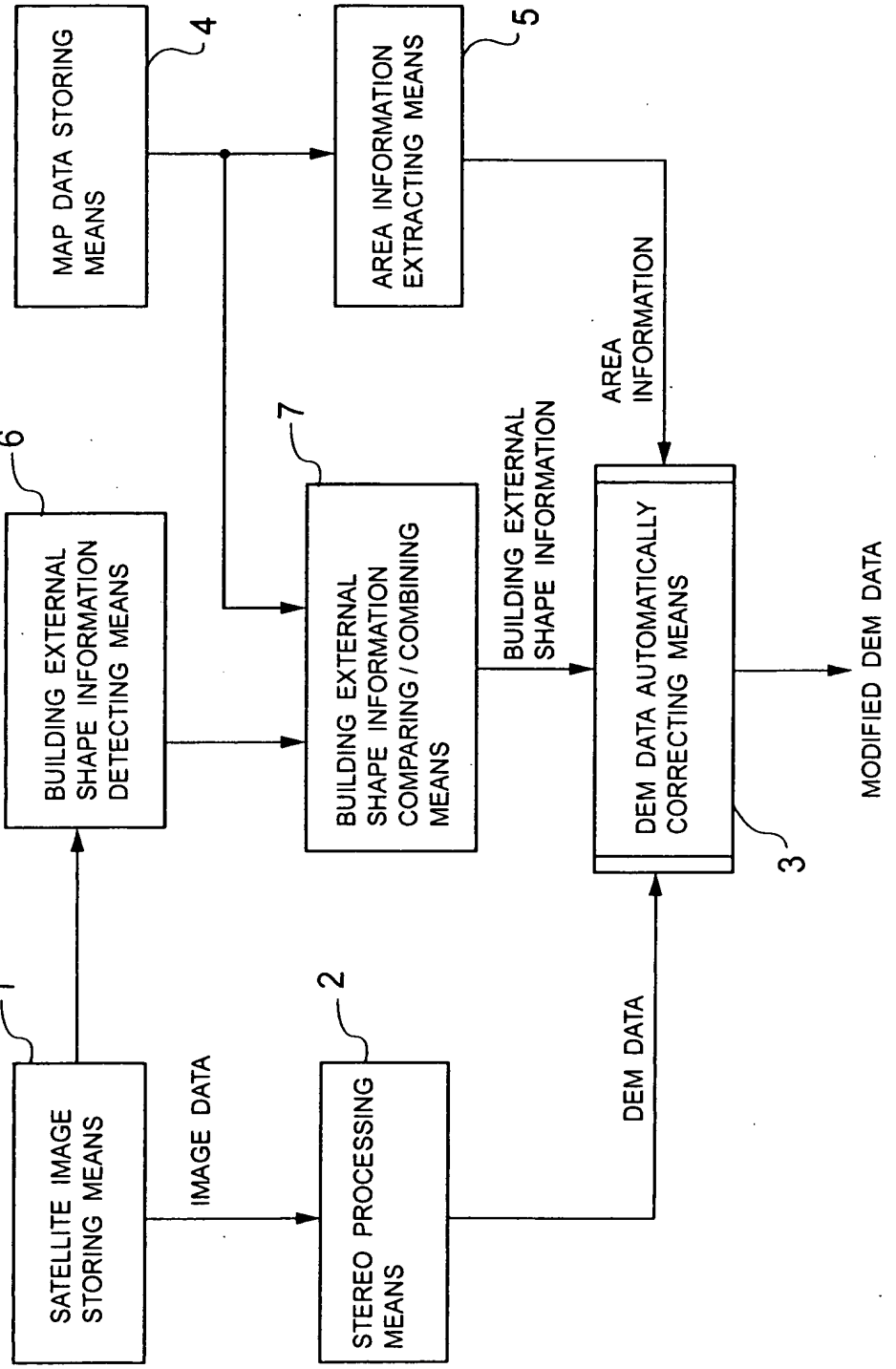

MAP DATA STORING MEANS
4
AREA INFORMATION EXTRACTING MEANS
5
AREA INFORMATION
6
BUILDING EXTERNAL SHAPE INFORMATION DETECTING MEANS
7
BUILDING EXTERNAL SHAPE INFORMATION COMPARING / COMBINING MEANS
BUILDING EXTERNAL SHAPE INFORMATION
DEM DATA AUTOMATICALLY CORRECTING MEANS
3
MODIFIED DEM DATA
1
SATELLITE IMAGE STORING MEANS
IMAGE DATA
2
STEREO PROCESSING MEANS
DEM DATA

FIG. 28

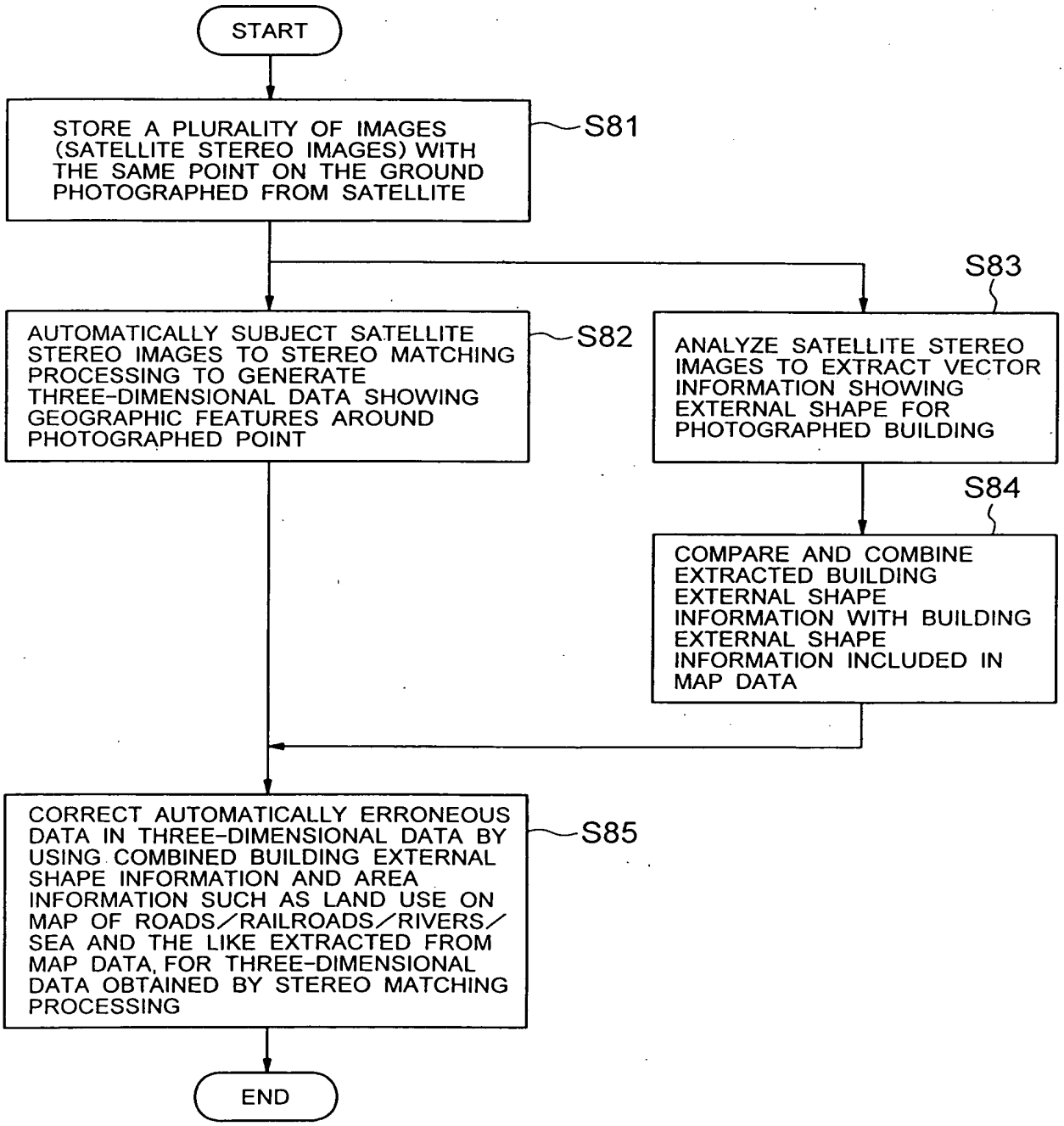


FIG. 29A

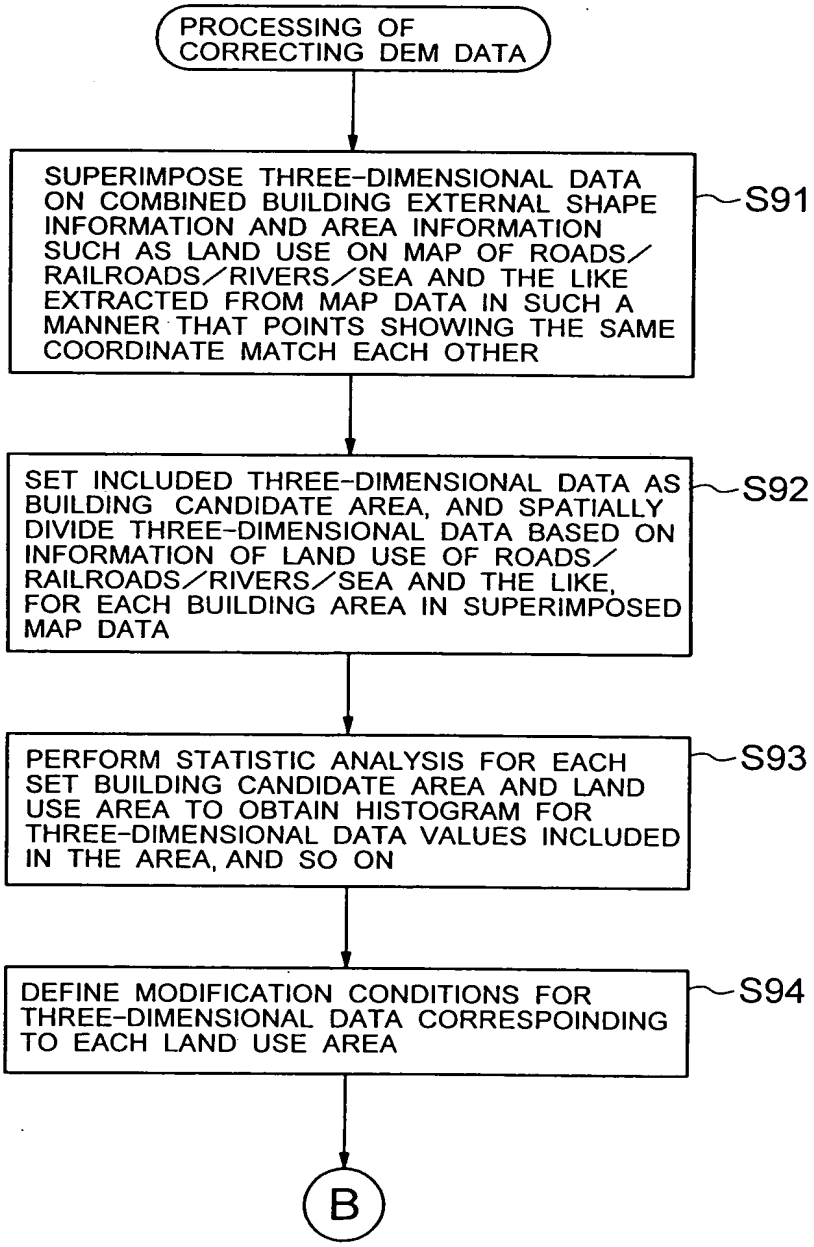

PROCESSING OF CORRECTING DEM DATA
SUPERIMPOSE THREE-DIMENSIONAL DATA ON COMBINED BUILDING EXTERNAL SHAPE INFORMATION AND AREA INFORMATION SUCH AS LAND USE ON MAP OF ROADS/RAILROADS/RIVERS/SEA AND THE LIKE EXTRACTED FROM MAP DATA IN SUCH A MANNER THAT POINTS SHOWING THE SAME COORDINATE MATCH EACH OTHER
S91
SET INCLUDED THREE-DIMENSIONAL DATA AS BUILDING CANDIDATE AREA, AND SPATIALLY DIVIDE THREE-DIMENSIONAL DATA BASED ON INFORMATION OF LAND USE OF ROADS/RAILROADS/RIVERS/SEA AND THE LIKE, FOR EACH BUILDING AREA IN SUPERIMPOSED MAP DATA
S92
PERFORM STATISTIC ANALYSIS FOR EACH SET BUILDING CANDIDATE AREA AND LAND USE AREA TO OBTAIN HISTOGRAM FOR THREE-DIMENSIONAL DATA VALUES INCLUDED IN THE AREA, AND SO ON
S93
DEFINE MODIFICATION CONDITIONS FOR THREE-DIMENSIONAL DATA CORRESPOINDING TO EACH LAND USE AREA
S94
B

FIG. 29B

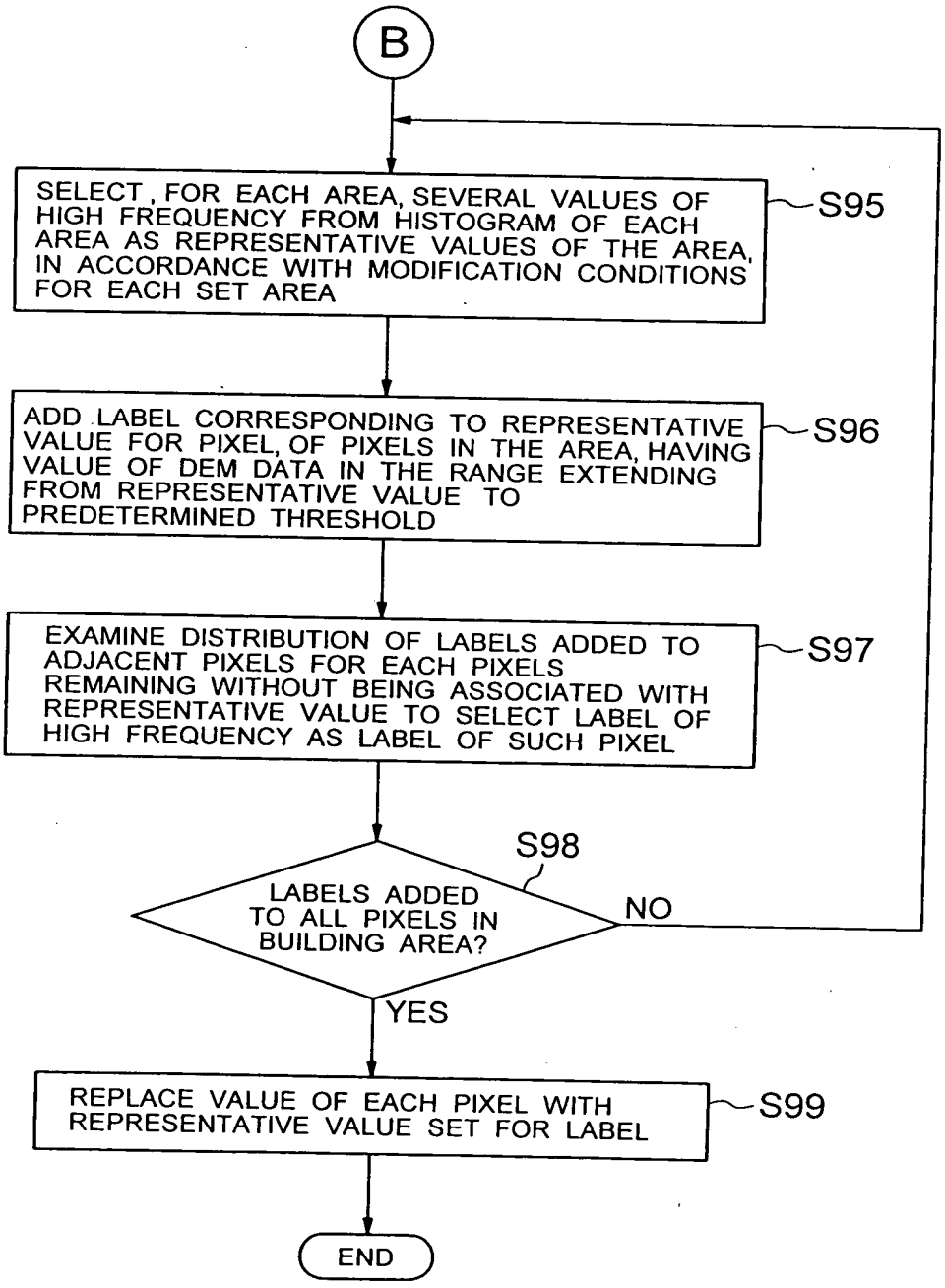


FIG.30

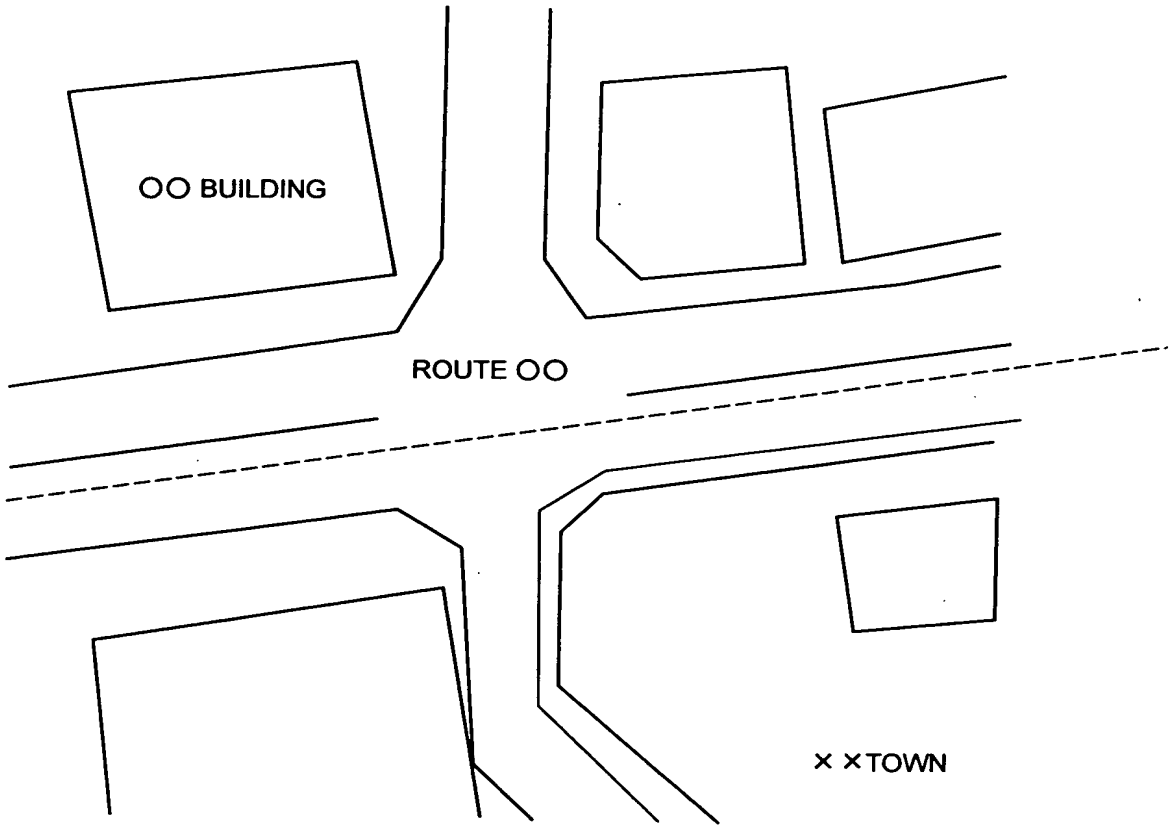


FIG. 31

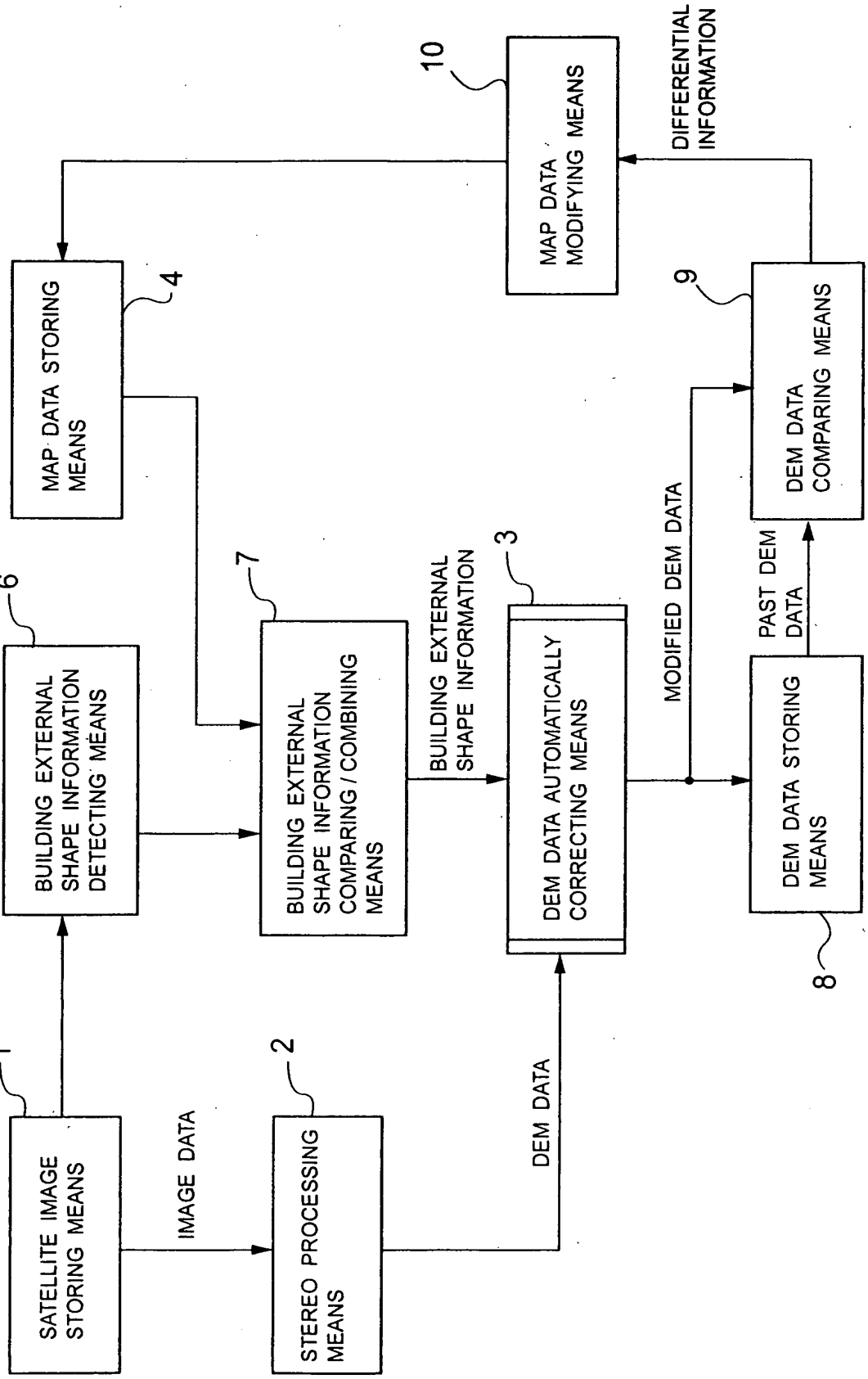

SATELLITE IMAGE STORING MEANS
1
IMAGE DATA
STEREO PROCESSING MEANS
2
DEM DATA
DEM DATA AUTOMATICALLY CORRECTING MEANS
3
BUILDING EXTERNAL SHAPE INFORMATION
BUILDING EXTERNAL SHAPE INFORMATION COMPARING / COMBINING MEANS
7
BUILDING EXTERNAL SHAPE INFORMATION DETECTING MEANS
6
MAP DATA STORING MEANS
4
MAP DATA MODIFYING MEANS
10
DIFFERENTIAL INFORMATION
DEM DATA COMPARING MEANS
9
MODIFIED DEM DATA
PAST DEM DATA
DEM DATA STORING MEANS
8

FIG. 32

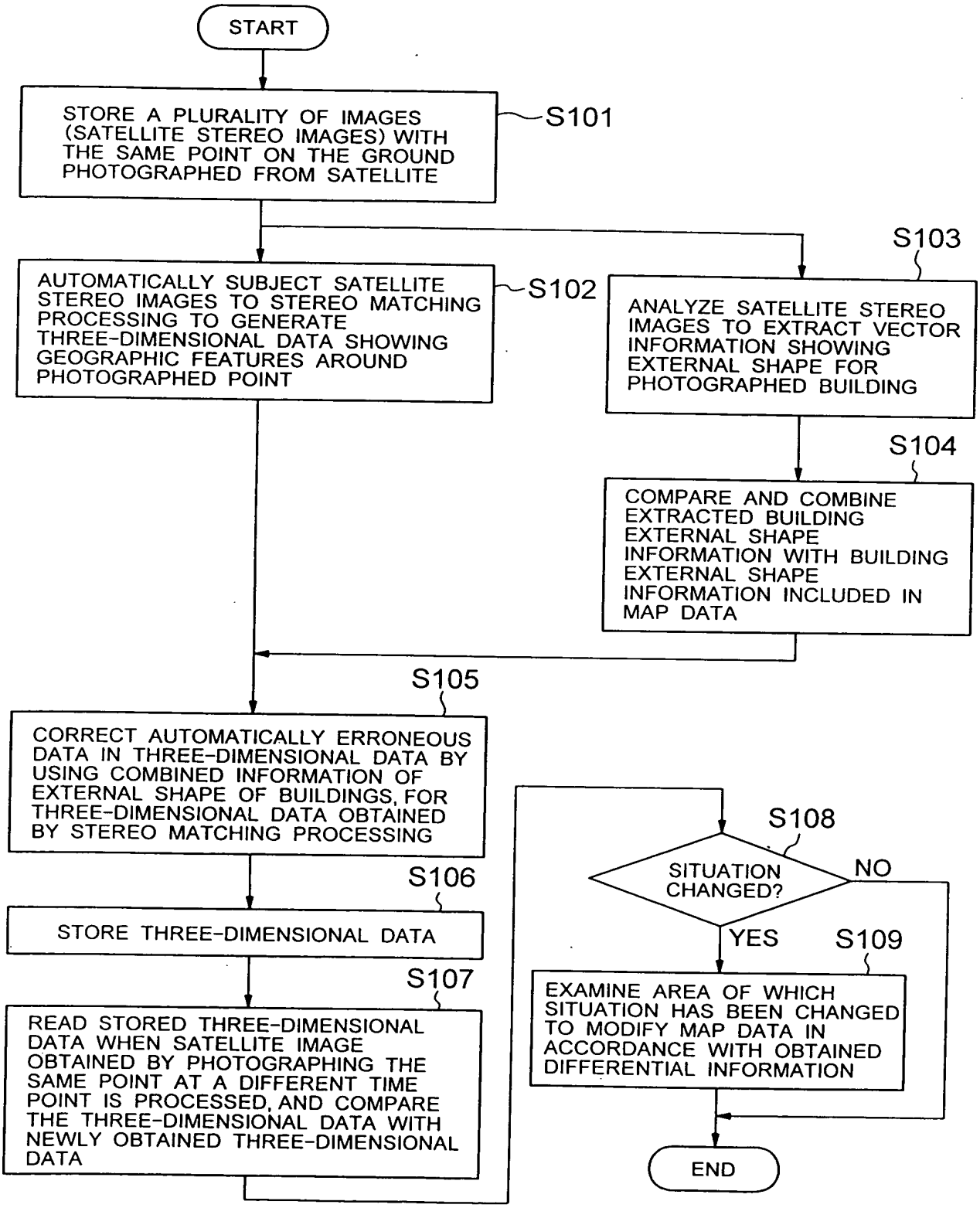
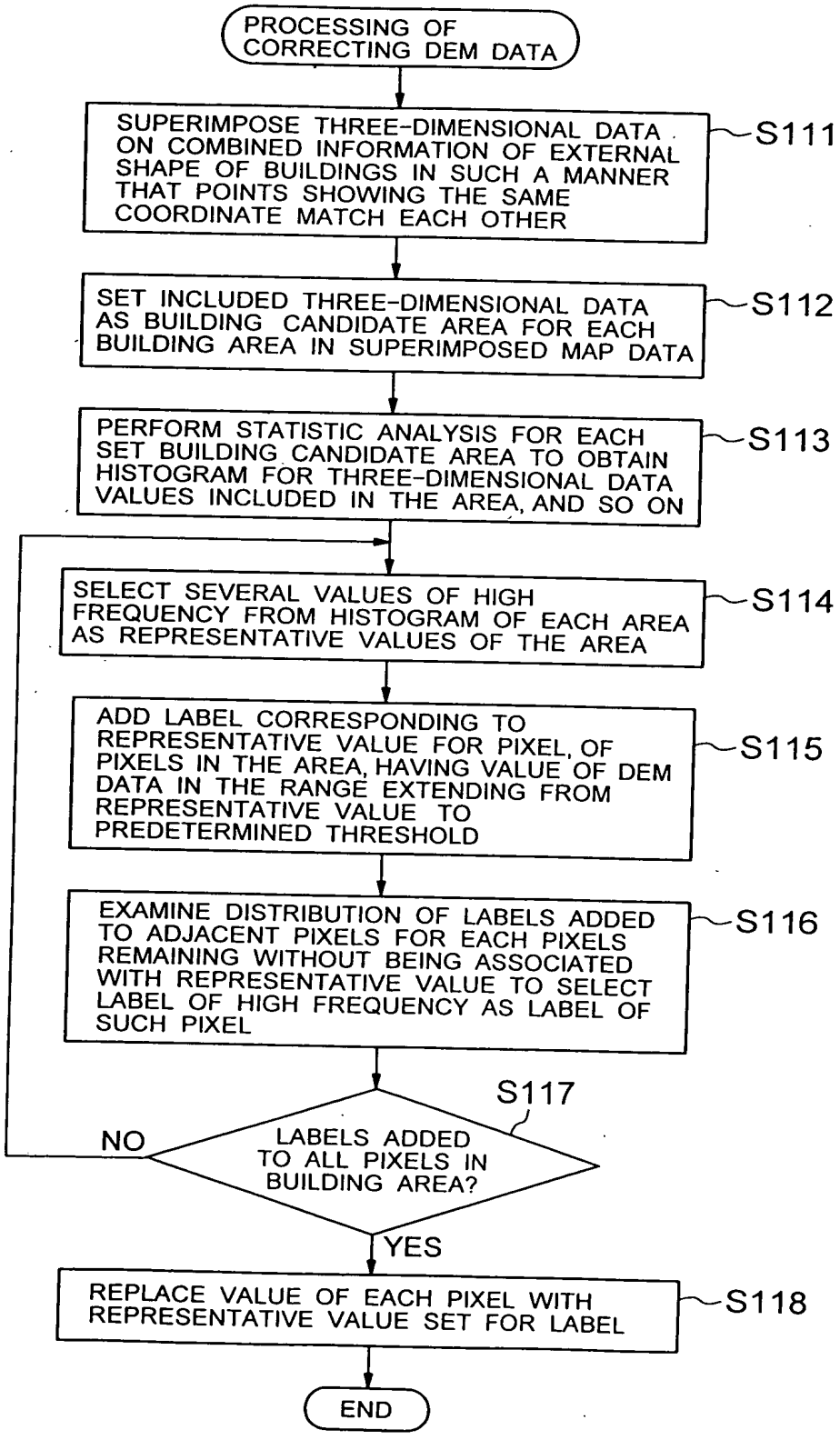

START
STORE A PLURALITY OF IMAGES (SATELLITE STEREO IMAGES) WITH THE SAME POINT ON THE GROUND PHOTOGRAPHED FROM SATELLITE
S101
AUTOMATICALLY SUBJECT SATELLITE STEREO IMAGES TO STEREO MATCHING PROCESSING TO GENERATE THREE-DIMENSIONAL DATA SHOWING GEOGRAPHIC FEATURES AROUND PHOTOGRAPHED POINT
S102
S103
ANALYZE SATELLITE STEREO IMAGES TO EXTRACT VECTOR INFORMATION SHOWING EXTERNAL SHAPE FOR PHOTOGRAPHED BUILDING
S104
COMPARE AND COMBINE EXTRACTED BUILDING EXTERNAL SHAPE INFORMATION WITH BUILDING EXTERNAL SHAPE INFORMATION INCLUDED IN MAP DATA
S105
CORRECT AUTOMATICALLY ERRONEOUS DATA IN THREE-DIMENSIONAL DATA BY USING COMBINED INFORMATION OF EXTERNAL SHAPE OF BUILDINGS, FOR THREE-DIMENSIONAL DATA OBTAINED BY STEREO MATCHING PROCESSING
S106
STORE THREE-DIMENSIONAL DATA
S107
READ STORED THREE-DIMENSIONAL DATA WHEN SATELLITE IMAGE OBTAINED BY PHOTOGRAPHING THE SAME POINT AT A DIFFERENT TIME POINT IS PROCESSED, AND COMPARE THE THREE-DIMENSIONAL DATA WITH NEWLY OBTAINED THREE-DIMENSIONAL DATA
S108
SITUATION CHANGED?
NO
YES
S109
EXAMINE AREA OF WHICH SITUATION HAS BEEN CHANGED TO MODIFY MAP DATA IN ACCORDANCE WITH OBTAINED DIFFERENTIAL INFORMATION
END

FIG. 33



Title: STEREO IMAGE PROCESSING
APPARATUS AND METHOD OF PROCESSING
STEREO IMAGE
Inventor(s): Hisao FURUKAWA
Docket No. 053969-0132

FIG.34

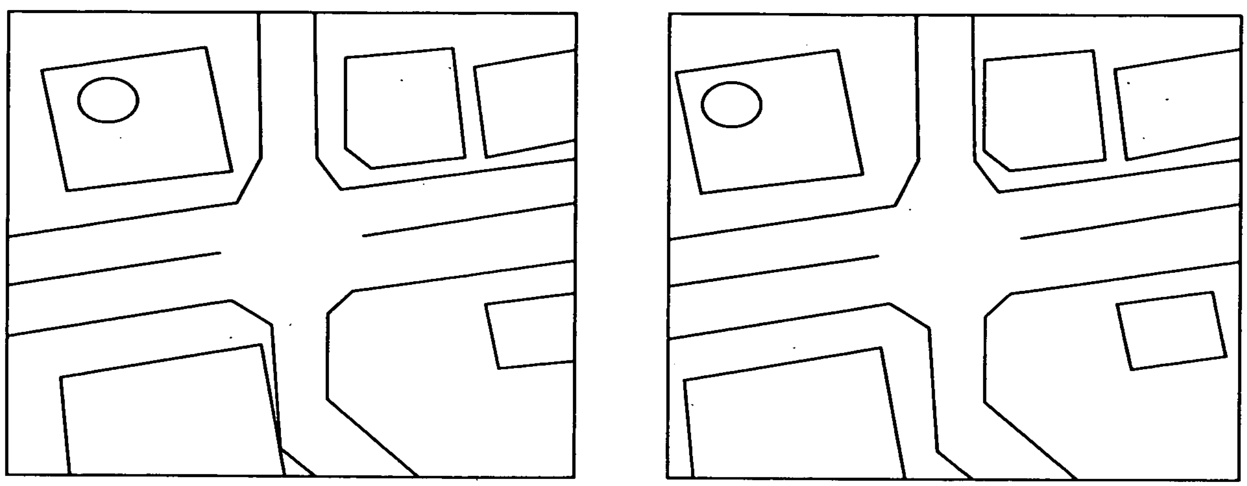


FIG.35

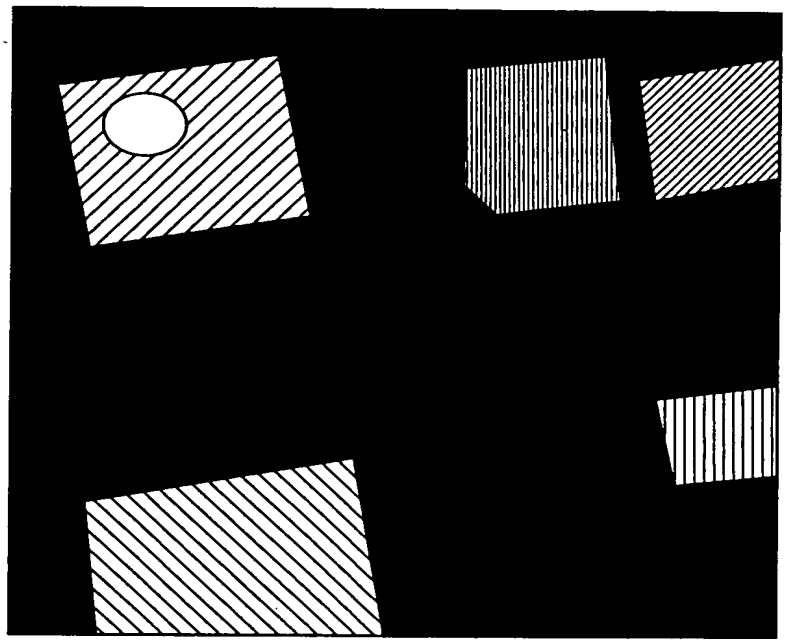


FIG.36

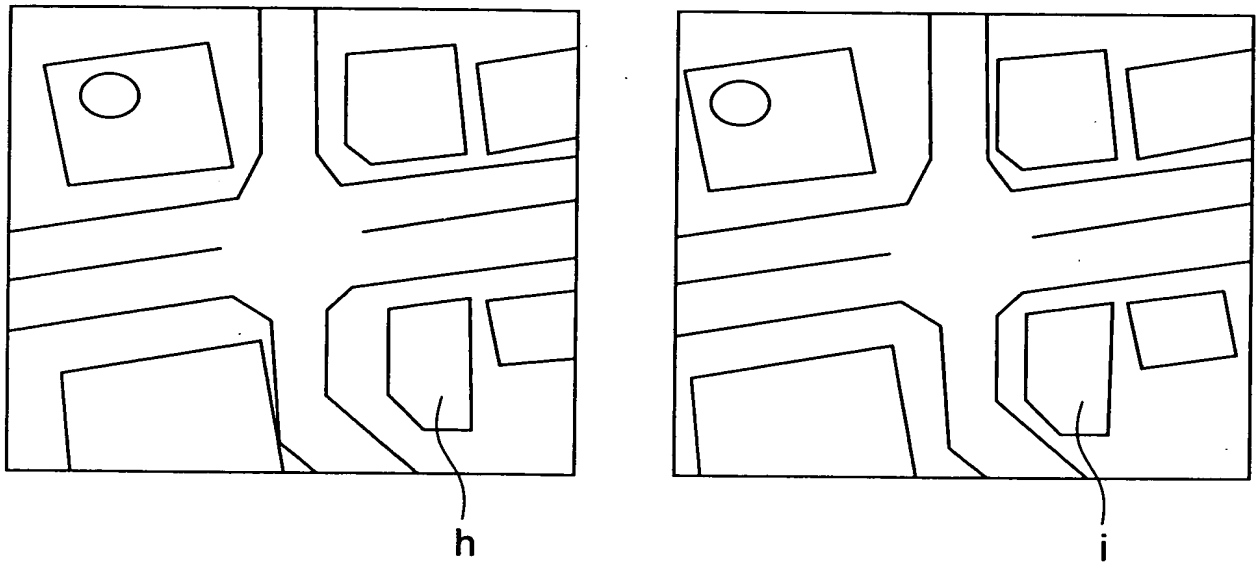


FIG.37

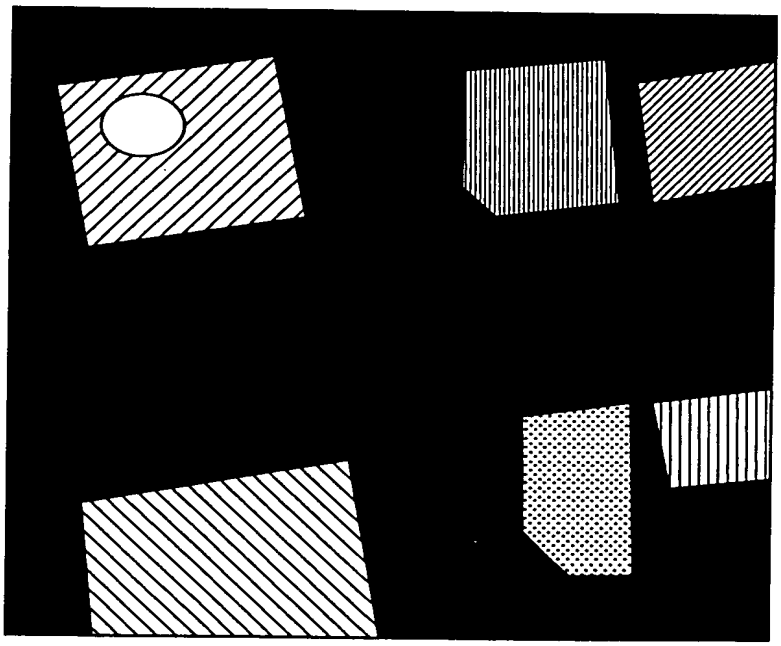


FIG.38

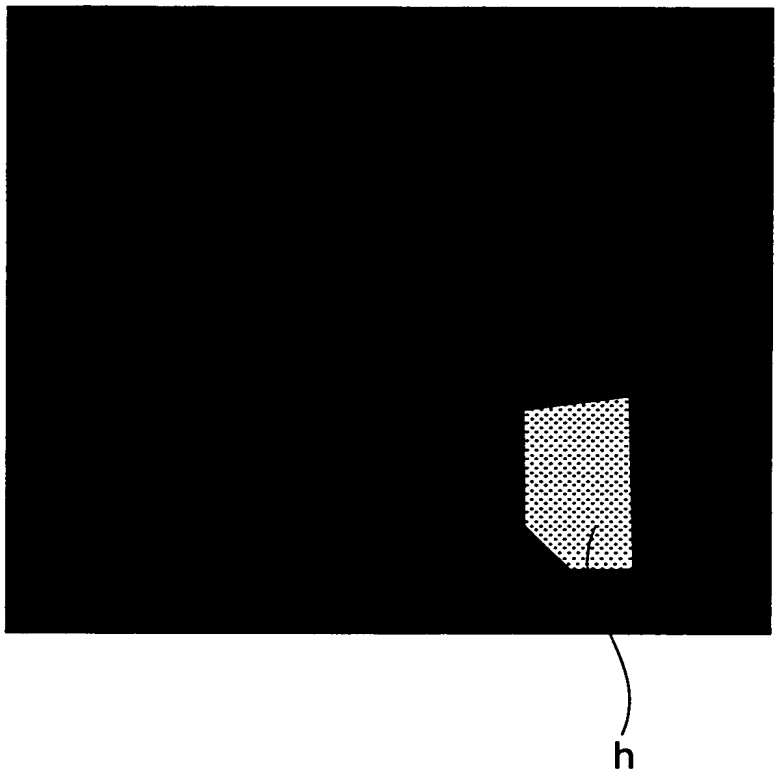


FIG.39

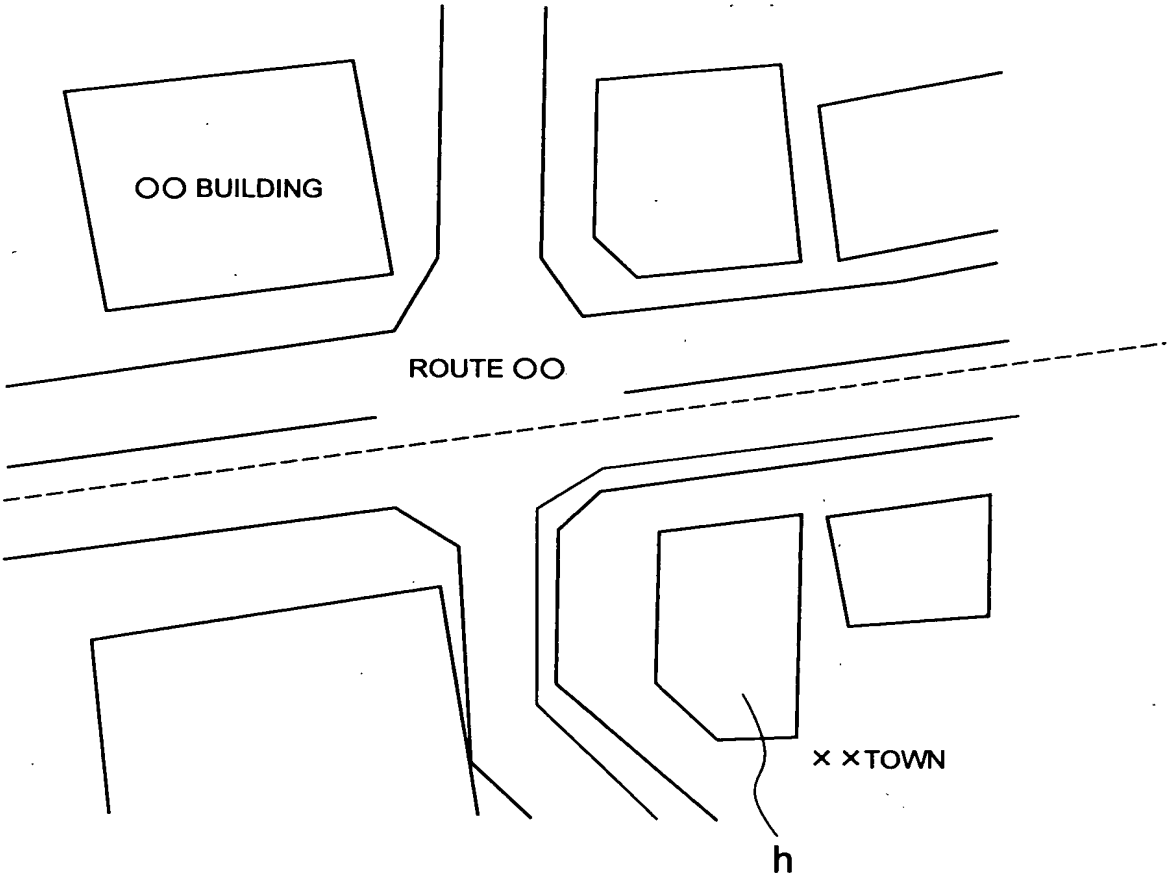


FIG. 40

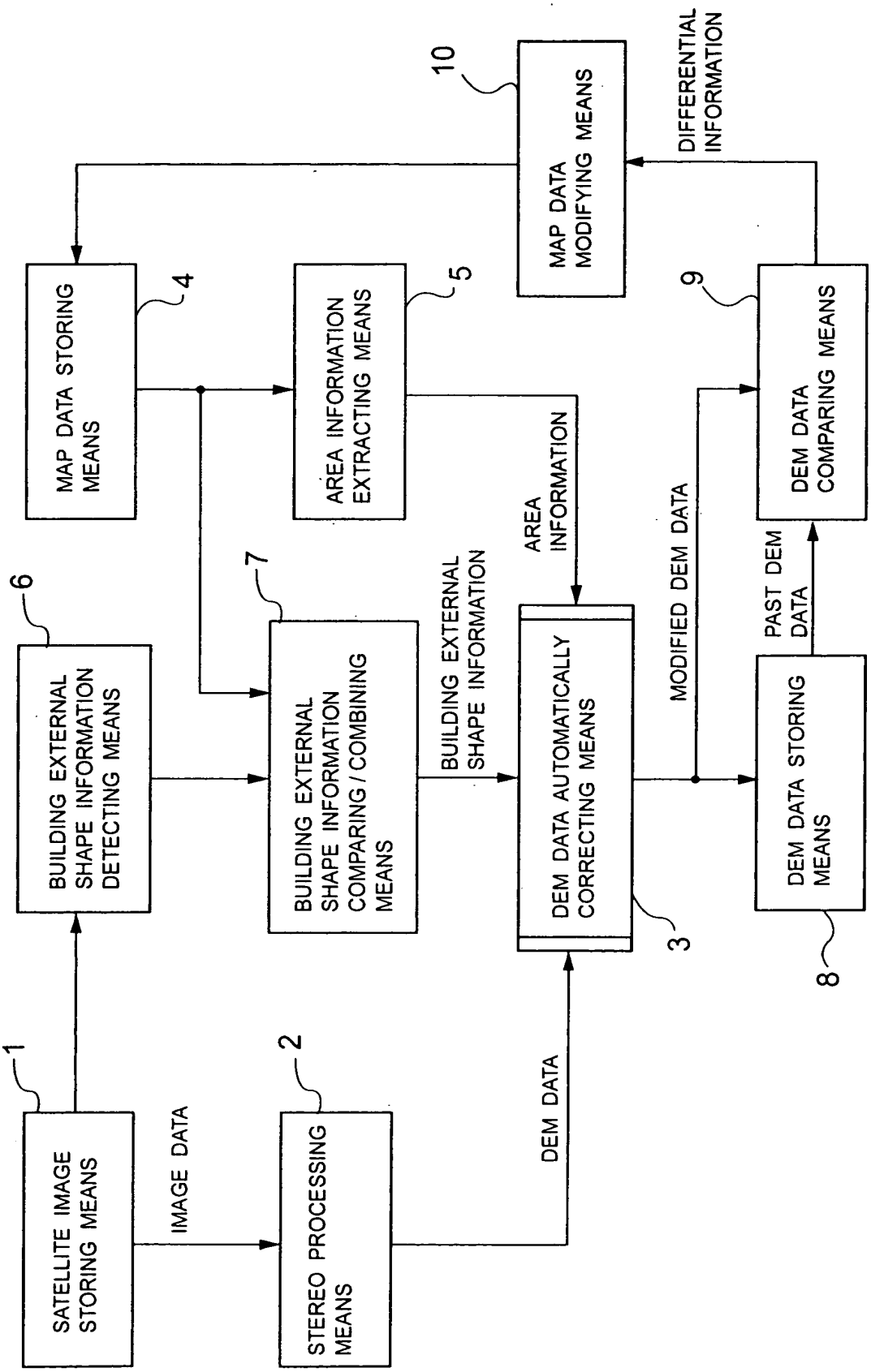

SATELLITE IMAGE STORING MEANS
1
IMAGE DATA
STEREO PROCESSING MEANS
2
DEM DATA
DEM DATA AUTOMATICALLY CORRECTING MEANS
3
MODIFIED DEM DATA
DEM DATA STORING MEANS
8
PAST DEM DATA
DEM DATA COMPARING MEANS
9
DIFFERENTIAL INFORMATION
MAP DATA MODIFYING MEANS
10
MAP DATA STORING MEANS
4
AREA INFORMATION EXTRACTING MEANS
5
AREA INFORMATION
BUILDING EXTERNAL SHAPE INFORMATION DETECTING MEANS
6
BUILDING EXTERNAL SHAPE INFORMATION COMPARING / COMBINING MEANS
7
BUILDING EXTERNAL SHAPE INFORMATION

FIG. 41

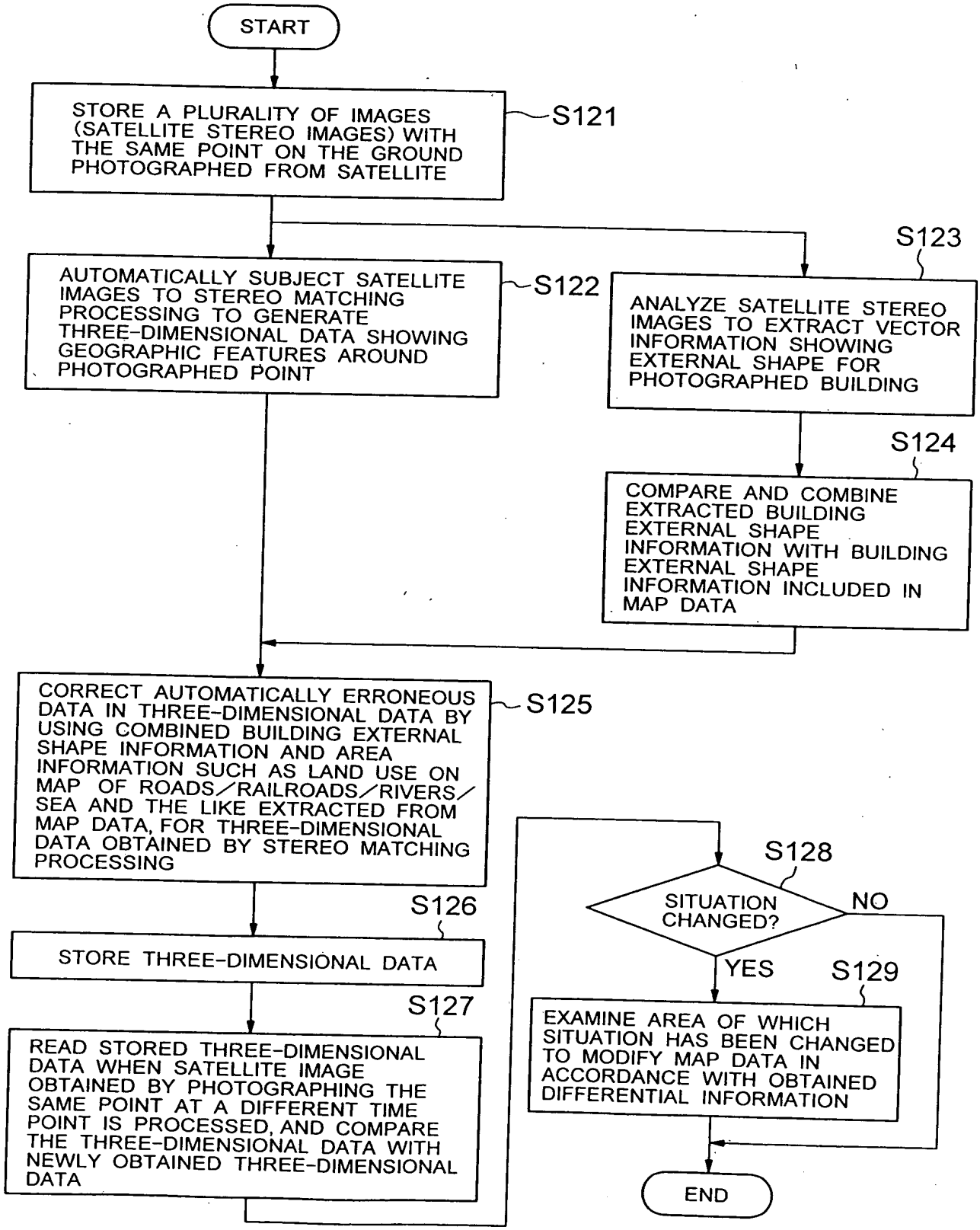


FIG. 42A

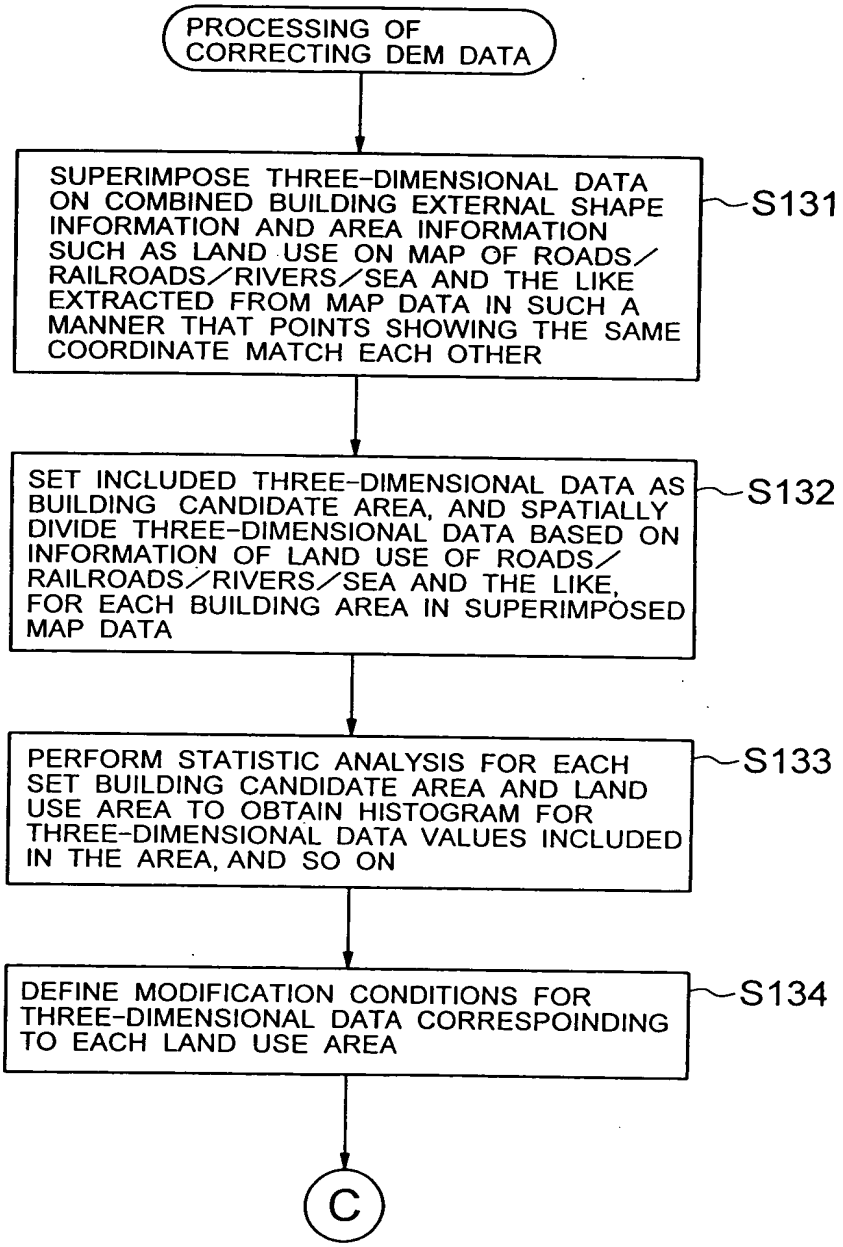


FIG. 42B

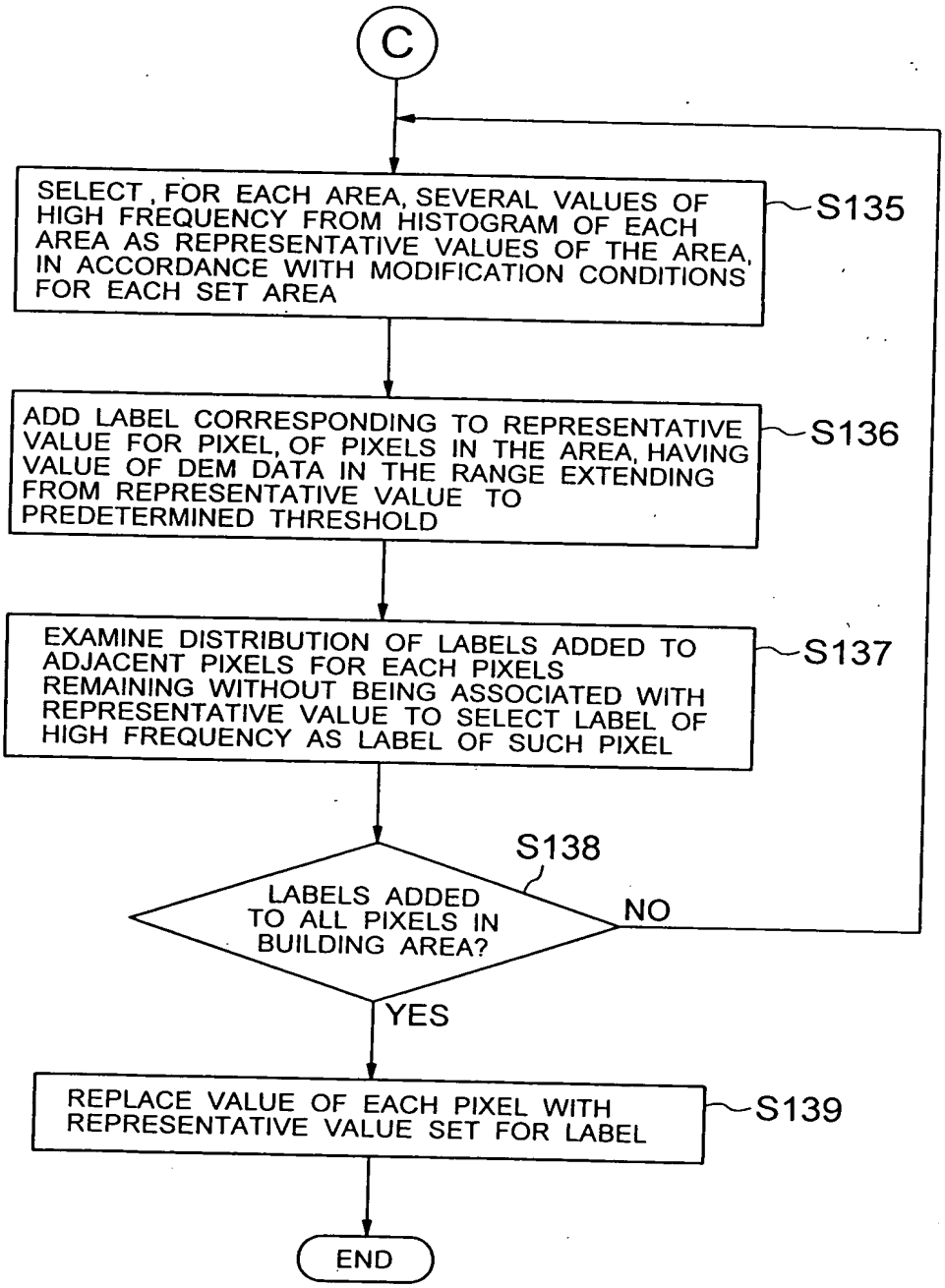
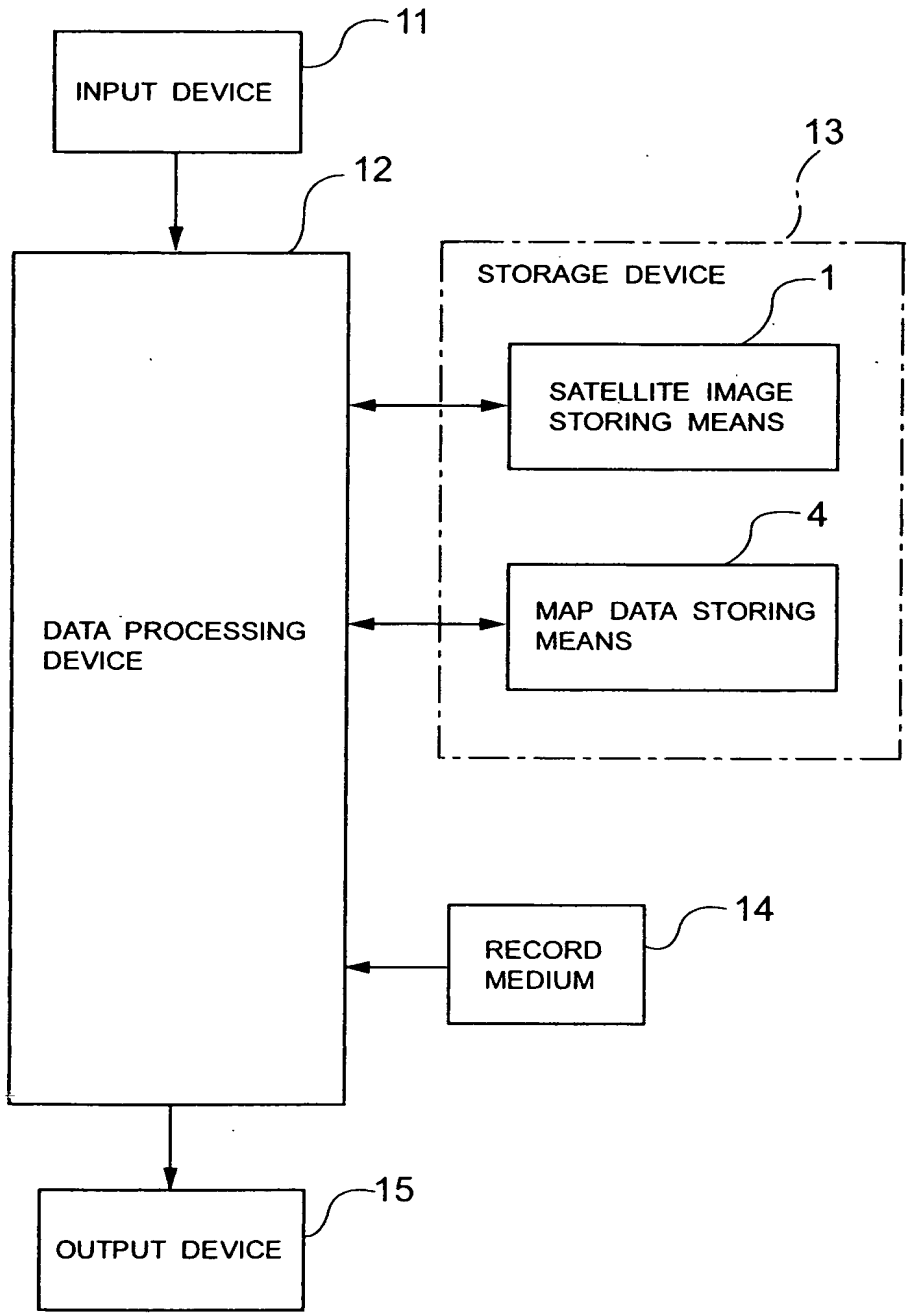

C
SELECT, FOR EACH AREA, SEVERAL VALUES OF HIGH FREQUENCY FROM HISTOGRAM OF EACH AREA AS REPRESENTATIVE VALUES OF THE AREA, IN ACCORDANCE WITH MODIFICATION CONDITIONS FOR EACH SET AREA
S135
ADD LABEL CORRESPONDING TO REPRESENTATIVE VALUE FOR PIXEL, OF PIXELS IN THE AREA, HAVING VALUE OF DEM DATA IN THE RANGE EXTENDING FROM REPRESENTATIVE VALUE TO PREDETERMINED THRESHOLD
S136
EXAMINE DISTRIBUTION OF LABELS ADDED TO ADJACENT PIXELS FOR EACH PIXELS REMAINING WITHOUT BEING ASSOCIATED WITH REPRESENTATIVE VALUE TO SELECT LABEL OF HIGH FREQUENCY AS LABEL OF SUCH PIXEL
S137
S138
LABELS ADDED TO ALL PIXELS IN BUILDING AREA?
NO
YES
REPLACE VALUE OF EACH PIXEL WITH REPRESENTATIVE VALUE SET FOR LABEL
S139
END

FIG. 43


11
INPUT DEVICE
12
13
STORAGE DEVICE
1
SATELLITE IMAGE STORING MEANS
4
MAP DATA STORING MEANS
DATA PROCESSING DEVICE
14
RECORD MEDIUM
15
OUTPUT DEVICE